A STUDY ON MORPHOLOGY AND THE ARTERIAL SUPPLY OF VERMIFORM APPENDIX

DISSERTATION SUBMITTED FOR THE DEGREE OF

MS (ANATOMY) - BRANCH – V TO THE TAMIL NADU

DR. M.G.R. MEDICAL UNIVERSITY CHENNAI

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CERTIFICATE

This is certify that dissertation entitled "**A STUDY ON MORPHOLOGY AND THE ARTERIAL SUPPLY OF VERMIFORM APPENDIX IN 50 CADAVERS IN TAMIL NADU** " Submitted by Dr.M. GOVINDARAJAN to the Tamil Nadu Dr. M.G.R Medical University, Chennai, is in partial fulfillment of the requirement for the award of M.S (Anatomy) Degree Branch – V and is a bonafide research work carried out by him under direct supervision and guidance.

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DECLARATION

This dissertation on "A study on Morphology and the Arterial supply of vermiform appendix in 50 cadavers in Tamilnadu is submitted to the Tamilnadu Dr. M.G.R. Medical University in partial fulfillment of the university regulations for the degree of M.S. Anatomy.

This study was carried out by me from 2004 to 2006 under the guidance and supervision of **Dr. T. HARIHARAN, M.S.,** Director and Professor of Anatomy, Institute of Anatomy, Madurai Medical College, Madurai.

The dissertation has been written in my original work and has not previously found the basis for the award of any Degree, Diploma, Associateship, Fellowship or other similar title or prizes.

Place: Madurai-20

Date: .10.2006. **(M. GOVINDARAJAN)**

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CONTENTS

INTRODUCTION

It is mysterious to say that appendix is a vestigial organ, as per the usual teaching in anatomy. Since it is a part of the large gut and the narrowest part of the alimentary tract, it should not be considered as vestigial organ. Much work has been done on its structural patterns, but only meagere work on its functional aspects. So there are unknown facts yet to be elucidated, about its functional aspects. As such appendix possess all the histological features, general for the large intestine without even a small layer in its degeneration.

In modern days there is much of scientific improvement so as to utilise the appendix as a grafting organ to close the fistulae so it must be considered as an evolving organ and not as vestigial organ. There are not well proved phylogenetic evidences to consider appendix as a vestigial organ. So phylogenetically and anatomically it must be considered as evolving organ with much surgical significance.

The prevalence of appendicitis is very common in almost all countries. But the diagnosis of appendicitis at times is very difficult, because of varying directions and position of its shaft and tip. So in clinical practice the surgeons usually give differential diagnosis and only after laparotomy, it is possible to come to a definite diagnosis. So the clinical features of appendicitis may mimic, for example in females salphingitis, oopheritis etc., and in both sex pararectal infections and pelvic peritonitis. Moreover the direction of appendix may be such that appendicitis may give rise to general peritonitis in the abdominal cavity or pelvic peritonitis.

The appendix may be found almost any where in the abdominal cavity depending upon its size, development and rotation of the gut. Position of the base of the appendix in relation to different shapes of the caecum varies for example in infantile type base at the apex of the caecum. The quadrate type the base is in the depression between the two sacs.

At times the diagnosis is so difficult if its position is retrocolic or post-ileal . For example if it is postileal, the position of appendix is between the two layers of mesentry. Where appendicitis gives rise to arteritis of the superior mesenteric artery with superior

mesenteric occlusion, which is a dreadful complication which leads to gangrene of the gut supplied by that artery.

When the arterial supply is considered, the position of the artery is within the mesoappendix with its terminal part directly lying in contact with the appendicular wall with its veins and lymphatics. In such cases infections of the appendix leading to arteritis and venous stasis leading to ischemia and gangrene of the appendix.

It has varying arterial supply from anterior caecal , posterior caecal or directly from the ileocolic artery. The aterial supply may be single, double or trible. During appendicectomy the arteries should be ligated individually, otherwise undue bleeding and haematoma formation in the right iliac fossa will occur .

Modern advancement in surgery utilises any tiny insignificant part of the body for some other great useful purposes. In repair of ruptured urethra (urethroplasty), the use of various tissues as the free grafts resulted in failure due to tissue necrosis.

But using appendicular mucosa was observed to be an effective substitute for successful urethroplasty. The size and cylindrical structure of the appendix and its easy resection make it an original and adopted uretheral substitute.

The present study is intended to throw more light on the morphology and the arterial supply of vermiform appendix in South Indian population and to help the surgeons engaged in abdominal operations in this part of the country

REVIEW OF LITERATURE

In Egyptian civilization (3000 BC), during the mummification process, abdominal parts were removed and placed in Coptic jars. The description of the jars was made by inscriptions. From the inscription the appendix was probably first noted as the "worm of the intestine".

The Leonardo da vinci (1492) was the first person to described the appendix in his drawings. In 1521 Berengario-de-corpi, a Professor of Anatomy in Bologne described the subcaecal position of appendix.

Vidiouldiur (1530) named the organ as Vermiform appendix.

Andrew Vesalius (1543) explained in detail about the vermiform appendix in his book "DE HUMANI CORPORIS FABRIC".

Morgagini (1790) first reported the congenital absence of vermiform appendix.

Francois Melier (1827) was the first person to study the different position and shape of vermiform appendix.

Luschka (1861) reported the appendix with length of 23cms in male cadaver.

Sir Fredric Treves (1885) studied the relationship between the ceacum, appendix and ileum.

Grauer, Kelly and Hurdon (1890) reported the longest appendix of 33cms in post mortem specimen.

Cladio (1892) reviewed the work done by Melier on position and shape of the appendix and reported that the average length of appendix to be 8cms, and the longest measuring about 20cms.

Bryant (1893) has reported that, the average length of appendix was 8.25cms and the shortest was 0.6cms in length.

Bery (1895) studied the length of appendix in 100 cadavers. The following observations were made:-

I. The average length of appendix was 8.3cms and ranged between 3.1cms to 13.3cms.

II. The average diameter of appendix was 0.6cms at the base.

Unusually long Vermform appendix reported by Fawcet in 1895 and subsequently by Tyson in 1896.

Hedinger (1904) reported a case of diverticulam of the appendix. Kelly and Hurdon (1905) reviewed the structure of appendix and described the appendicular diseases in detail.

Holmes (1904) studied the length of appendix in cadavers and reported that, it was ranging between 6 to 10cms.

Kelly and Hurdon (1905) studied the morphology of appendix and made the following observations:-

I. The length of appendix was ranged between 9 to 10cms.

II. The average diameter at the base was 1cm.

Weaver and Black (1905) reported the longest appendix of 25.5cms and 24cms respectively.

Berry (1906) studied the relation of appendix and caecum. Davis, Harington, Weir and Fowler (1906) described the various modes of performing appendicectomy and various types of skin incision used.

Now Kci (1909) studied the length and diameter of the appendix and reported the average length to be 8.4cms and the diameter was 7mm.

Deaver (1913) studied the morphology of appendix in 200 cadavers. The following findings were made:-

I. The shortest appendix was 1cms in length.

II. The longest appendix was 23cms in length.

III. The average diameter of appendix was 0.6cms.

Gladstone (1915) reported a case of congenital absence of appendix and Schrup (1915) described a case of left sided appendix.

Macphil (1917) studied the appendix in 220 postmortem cases and observed the following findings. The average length of appendix was 9.9cms the average diameter was about 6mm at its base and the appendix was found to be longer in males .

Arthur Robinson (1923) studied the length and diameter of appendix in 100 cadavers and observed the following parameters:-

I. The shortest appendix was 1.8cms in length.

II. The longest appendix was 23cms in length.

III. The average length was 9.2cms.

IV. The average diameter of appendix was 0.6cms at the base.

Gladstone and Wakeley (1923) studied the various positions of appendix in three thousand cases and made the following observations:-

I. POSITION OF THE APPENDIX

1. Retrocaecal and Retrocolic positions in 69.2%.
2. Pelvic in 27.5%.
3. Sub-caecal in 1.86%.
4. Preileal in 0.9%.
5. Post-ileal in 0.5%.
6. Ectopic in 0.033%.

Donald (1927) reported a case of congenital reversed rotation of the gut with left sided appendix.

Royster (1927) studied the morphology of appendix and reported that the average length was 7.5cms and it ranged between 2.5 to 29.4cms. The average diameter was 0.6cms.

Wakeley (1933) analysed the position of Vermiform appendix in Ten thousand cases and reported that the commonest position was retrocaecal (65.28%). The next most common position was Pelvic (31.01%), followed by Subcaecal (2.26%), Preileal (1%) and Postileal (0.4%). The remaining 0.05% the appendix was associated with the ectotipically placed caecum and also reported the relative rarity of absence of appendix.

Velluda (1936) reported a case of congenital absence of both caecum and appendix. Waugh (1941) reported a rare case of dublex of vermiform appendix.

Donald Collins (1931) analysed the morphology of appendix in 4680 specimens and observed the following findings:-

I. THE LENGTH OF APPENDIX.

1. The shortest appendix was 0.3cms.
2. The longest appendix was 24.5cms.
3. The average length of appendix was 8.21cms.
4. The average length of appendix in male was 0.68cms more than that of female.

II. POSITION OF THE APPENDIX.

1. Retrocaecal and Retrocolic in 21.5%.
2. Pelvic in 50%.
3. Sub-caecal in 1.24%.
4. Preileal in 1%.
5. Post-ileal in 0.71%.
6. Ectopic in 1%.

Waugh (1941) reported a case of duplication of the appendix without duplication of ceacum and found that the cavities of the two appendix were communicating with each other.

Capone (1946) reported a left sided appendix in dextro cardiac patient.

Shah & Shah (1946) studied the arterial pattern of appendix in 60 Pakistani cadavers and described seven various modes of arterial pattern of appendix.

TYPE I PATTERN :-

The appendicualr artery was from the ileco colic artery and supplying the appendix after dividing into three or four subdivisions in the mesoappendix, near the appendicular wall.

TYPE II PATTERN:-

The appendicular artery had it origin from the ileo colic artery, bifurcated immediately in the mesoappendix and supplying the appendix, making free anastamosis with each other.

TYPE III PATTERN:-

The appendicular artery arose from the ileo colic artery, trifurcated immediately in the mesoappendix and supplied the appendix.

TYPE IV PATTERN:-

The appendicular artery was arising from the posterior caecal artery.

TYPE V PATTERN:-

There were two appendicular arteries, one from the anterior caecal and another from posterior caecal artery. There were free anastamosis between each osther in the meso appendix.

TYPE VI PATTERN:-

There were two appendicular arteries. Both were arising from posterior caecal artery.

TYPE VII PATTER:-

Again two appendicualr arteries arising from anterior caecal artery.

Singleton and King (1951) described a case of persistent vitellointestinal duct which was continuous with vermiform appendix.

Collins (1951) and Robbinson (1952) observed the cogenital absence of appendix

Doughlas (1954) reported a rare case of congenital absence of entire right colon along with caecum and appendix.

J.K. Wah (1958) again reported a case of appendix duplex. Maisol (1960) analysed the position of appendix in different age groups and reported that anomalies were common in childhood

Pester & Elas (1965) and Hutt in 1967 again reported a case of absence of appendix.

Solanke (1970) studied the morphology of appendix in Nigerians and reported the increased frequency of pelvic position, the relative rarity of appendicitis in Africans, due to the dual blood supply.

Romanenko (1973) studied the various position of appendix in Russian population and described the various mode of surgical procedures for different positions.

Mikat (1976) reported a case of helical appendix.

Budd D C, Fouty W J etall (1977) reported a retrocaecal appendix in 16 patients of same family and found that the retrocaecal position of appendix was inherited as a simple dominant unit character.

Ures J, Stacchini A, Prates J C, etall(1978) studied the arterial supply of vermiform appendix by anatomico-radiological method and established 6 different types of arterial patterns.

Katezarski M , Gopal rao U K and Brady (1979) studied the morphology and arterial pattern of vermiform appendix in 103 cadavers in Zambia and the following observations were studied:-

I. POSITION OF THE APPENDIX

1. Pelvic in 43.6%.
2. Retrocaecal in 20.3%.
3. Retrocolic in 20%.
4. The remaining positions in 16%.

II. LENGTH OF APPENDIX

1. The average length of appendix in male was 12cms.
2. The average length of appendix in female was 11.9cms.
3. Dual blood supply was found in 39.8% of cases.
4. They considered that the predominant pelvic position and more frequent dual blood supply would be the cause for rarity of appendicitis noted in Africans.

Bax and Pense (1980) reported a case of perforated appendix in the neonatal period.

Gerlock A J, Muhletapar C A, Berger J L etall (1981) reported a case of infarction of the caecum and appendix followed by a therapeutic embolization of ileo-colic artery for angiodysplasia, with a poor anastamosis between caecal and appendicular branches of ileo-colic artery.

Grundit Z T, Ryden C I, Janzon L(1983) observed the position of appendix in relation with different age groups and concluded that there was no definite association between the position of the appendix and different age group.

Abramson D J, etall (1983) reported a rare case of aberrant position of appendix which was located inside the posterior wall of ceacum. The serosal layer being absent for appendix.

Grundit Z T, Ryden C I, Janzon L (1983) studied the position of appendix in relation to age and the influence of the retrocaecal position of appendix on appendicitis. They concluded that there was no association between age and anatomical position of appendix but there was increased incidence of appendicitis related complications like intestinal obstruction occurring more frequently in retrocaecal position.

Ajmani M L and Ajmani K (1983) studied the length position and arterial pattern of appendix in 100 Indians in Uttar Pradesh State. The following observations were made:-

I. POSITION OF THE APPENDIX.

1. Retrocaecal in 68%.
2. Pelvic in 20%.
3. Postileal in 10%.
4. Preileal in 1%
5. Other rare position in 1%.

II. LENGTH OF THE APPENDIX

1. The average length of appendix in male was 9.5cms.
2. The average length of appendix in female was 8.7cms.
3. Double appendicular artery was noted in 39% of cases.

4. The increased incidence of postileal position in Indians would be the cause for serious appendicitis related complications like intestinal obstruction

Hashimoto S , Ogato T (1988) studied the blood vascular organization of a vermiform appendix using a methacrylat as a casting medium under the electron microscope.

They described three types of arterial pattern and observed that plenty of afferent arterioles from the appendicular artey pierced the muscular coat and forming sub-mucous plexus. From the sub-mucous plexus arterioles, pierced the mucosa to form a honeycomb plexus in the luminal surface of the mucosa.

Rukhalo V G, Bochinski V F etall (1988) reported a rare case of sub-hepatic caecum and appendix in both the mother and son.

Ojeifo J O, Ejiwunami A B and Iklaki J (1989) analysed the position of appendix in 548 Nigerians and found that retrocaecal position was the commonest in Nigerians and contradicted the earlier reports, stating that the retroceacal position was moderately infrequsent in African blacks.

Valla J S, Gharbin etall (1989) reported a rare case of ileo-caeco-appendicular agensis.

Karim O M, Boothroyed A E (1991) studied the position occupied by the appendix in relation to abdominal regions in 50 cases.

The following observations were made

1. In 59% of cases the appendix occupied the pelvic region.
2. In 15% of cases the appendix occupied the umbilical region.
3. In 11% of cases the appendix occupied the inguinal region
4. In 20% of cases the appendix occupied the right iliac region.

Drinkovic (1991) made a comparitive study of appendicitis and age distribution in Serbia and found that the appendicitis was common in the age group between 11 to 20 years.

Pitynski K, Skawina A and Gorczyca J Etall (1992) studied the variability of the arterial pattern of vermiform appendix in human dead fetus aged between 12 to 20 weeks of gestation by the injection methods and found that single appendicular artery was the commonest mode of supply and most of the time arising from the ileocolic artery.

Ramsten W H, Mannion R, (1993) studied the relation between the base of appendix and McBurney's point (junction of the lateral and

medial two thirds of a line joining the umbilicus with the right anterior superior iliac spine) and made the following observations

1. In 75% of cases the base of appendix situated medial to and within 5cms of McBurney's point.

2. In 20% of cases the base of appendix situated medial to and within 10cms of McBurney's point.\

3. In 5% of cases the base of appendix situated lateral to McBurney's point.

Myanwu S N, (1994) reported a case of agensis of vermiform appendix in 23 yrs old lady.

Lobert (1994) used appendix mucosa for uretheroplasty.

Wall Bernal J F, Gonzalezvek C, Garijo M F etall (1996) reported a rare case of primary acute torsion of appendix in 6 yrs old boy with abnormally long appendix of 13.5cms, which was Pelvic in position. They concluded that the abnormality in length and Pelvic position would be the precipitating factor for torsion .

Lentini , Sini R etall (1997) reported a case of abnormal implantation of appendix in the anterolateral wall of ascending colon, 15cms from the junction of taeniacoli of the caecum.

Bakheit M A, Warillie A A, (1999) studied the anomalies of the vermiform appendix and the prevalence of appendicitis in Saudi Arabians. The following observations were made:-

I. POSITION OF THE APPENDIX

1. Retrocaecal in 58.3%.
2. Pelvic in 21.7%.
3. Postileal in 10%.
4. Preileal in 2%.
5. Other rare positions in 8%.

Kaushal S, Batra A P S, Kaur M etall (2000) reported a rare case of absence of caecum but the appendix was fully developed and arose from the ascending colon.

Malas M.A, Gokcimen A, Solak D, (2001) made a comparative analysis between the growth of ceacum and the position of vermiform

appendix in 40 males and 40 females fetuses between 10 to 40 weeks of gestation. They found that ceacum was tubular in male fetus and sacculated in female fetus and the frequent position of appendix was subceacal in male fetuses (48%) post-ileal in female fetuses (34%).

Dubois and Bouhafs (2001) used the caecoappendicular unit for urinary bladder augementation and continent urinary diversion.

Retten Bachar T, Hollerweger A, etall (2001) analysed the outer diameter of appendix at the base as a tool to exclude the appendicitis in 278 patient and concluded that the outer diameter of more than 6mm was the indicator of acute appendicitis.

Solecki R, Madyja A, Miknowskiw (2001) described the two cases of right sided inguinal hernia containing inflamed subcaecal appendix as a content.

Chan, Totalwai-To, Cheng, Naomi etall (2002) made correlative study between the position of appendix and the outcome of appendicitis in Hong Kong. The following observations were made:-

I. Diagnosis of appendicitis was difficult and usually made late in retrocaecal and retrocolic positions.

II. Laproscopic appendicectomy was difficult and time consuming in retrocaecal and retrocolic positions.

III. Patient with retrocaecal and retrocolic positions had increased post operative complications and longer hospital stay.

Delic J, Sadkodic and Isakobic (2002) described the variations in the position and point of origin of appendix in Croatia in 500 cadavers. The following observations were made:-

I. POSITION OF THE APPENDIX

1. Retrocaecal in 38%.
2. Retrocolic in 13%.
3. Pelvic in 26%.
4. Subcaecal in 8%.
5. Paracaecal in 4%.
6. The remaining rare positions in 11%.

II. POSITION OF THE OSTIUM VERMIFORMIS APPENDIX

The position of ostium was situated in

1. In middle of the lower pole of caecum in 32% of cases.
2. In the lateral wall of caecum in 10%.
3. In the postromedial wall of caecum in 48%.
4. In the anterior wall of the caecum in 10%.

Harold Ellis (2002) described the morphology of appendix as:-

I POSITION OF THE APPENDIX

1. Retrocaecal and Retrocolic in 75%.
2. Pelvic in 18%
3. Preileal in 2.5%.
4. Post-ileal in 2.5%.
5. Sub-caecal in 2%.

Ferri E, Bonvilini U, Pisain M (2002) studied the diameter of appendix in 200 cases and reported that

1. The average diameter of appendix was 6.5mm (ranged between 7 to 9 mm)

2. Diameter variability along the length of same appendix was reported in 5% of cases.

3. The wall thickness of appendix was 2.5mm

J M Alapont, Broseta F, Oliver etall (2003) used a appendix to repair the ureteric avulsion occurred during ureteroscopic procedure.

Gopalipour M J, Arya P, Azar Hoosh R etall (2003) studied the position of appendix in 117 cadavers in south Iran. The following observations were made:-

I. The average length of appendix in male was 6.61cms.

II. The average length of appendix in female was 6.06cms.

III. POSITION OF THE APPENDIX

1. pelvic in 33.3%

2. Retrocaecal and Retrocolic in 32.4%.

3. Preileal in 18.8%.

4. Sub-caecal in 12.8%.

5. Post-ileal in 2.6%.

III. In 65.8% of cadavers the meso appendix failed to reach the tip. In 34.2% the meso appendix extended upto the tip.

They concluded that the racial factors influence the position of appendix.

Cave and Wall bridge (2004) studied the duplication of appendix and classified the conditions in to three types:-

Type I :- Partial duplication of appendix on a single caecum.

Type II:- Single caecum with two completely separated appendices.

Type III:- Two caeca with separate appendices.

Oguzkurt P, Kayasekuk F(2004) reported a rare case of torsion of the colon in a case with colonic duplication and a duplicated appendix.

Sai Sucheethra D, Sreelekha D etall (2005) reported a case of appendix which possessed appendices epiploicae in male cadaver.

Bailey & Love, short practice of surgery 23rd ED. (2005) described the morphology of appendix as follows:-

I. POSITION OF THE APPENDIX

1. It was retrocaecal in 42% of cases.
2. Retrocolic in 31% of cases.
3. pelvic in 25% of cases.
4. Preileal in 1%.
5. Postileal in 1%.

II. The length of appendix ranged between 1 to 25cms and average length was 5 to 7cms.

III. The luminal diameter ranged between 1 to 3mm.

Pararajasingam P, Gudur L D, Walker etall (2005) reported a case of necrotizing vasculitis involving appendicular artery in 15 yrs old girl.

Breitenstein S, Elsenbach C, Wille G (2005) etall reported a case of right sided inguinal hernia containing a subcaecal vermiform appendix.

Ndoye J.M, Ndoye A, Dia A, Fall B, etall (2005) analysed the cadaveric topography and morphometry of the vermiform appendix in 80 cadavers (62 men and 18 women) and found that the vermiform appendix was more often in the form of worm. Its mean length was 10.64cms, varied

between 6.5 to 16cms and it mean diameter was 0.6cms (range between 0.4 to 0.5cms). The distance between the base of appendix from the ilecocaecal junction varied between 15 to 40mm with mean distance of 24.2mm.

Sobhian B, etall (2005) reported a rare case of vermiformis duplex .

S. Gupta, R. Sharma, Koushik R, etall (2005) reported a rare case of inguinal hernia containing appendix as a content in a month old boy in Chundigarh, North India.

Kamiyana T, Fujiyoshi F etall (2005) reported a case of malrotation of the midgut with left sided appendix in 14yrs old boy.

Text book of Gray's Anatomy described the position of appendix as follows:-

1. It may be Retrocaecal or Retrocolic (Behind the caecum or ascending colon respectively)
2. Pelvic or descending (It hangs dependentl over the Pelvic brim, in close relation to the right uterine tube and ovary in females)

3. Subcaecal (below the caecum).

4. Pre-ileal (Anterior to the terminal ileum)

5. Post-ileal (Behind the terminal ileum)

II. The length of the appendix ranged between 2 to 20cms.

III. The appendix was relatively longer in children.

Sow M L (2005) studied the topography of appendix and intra peritoneal projection of McBurney's point in 80 cadavers in Africa. The following observations were made

1. The appendix situated in the McBurney's point in 66% .

2. The anterior disposition was common and occurred in 68.7% of cases

Fuijksehot J, Wijnen and Dupois (2006) reported a case of congenital umbilical appendix. In the same year Griffith E A and Jagadeesan J reported a case of bifid vermiform appendix.

Kevi Plaky M A, Charler Richard J etall in sabistone's text book of surgery (2006) described the position of appendix as retrocaecal in 65% Pelvic in 30% other position in 5%.

MATERIALS AND METHODS

The study was conducted at the Madurai Medical College, Madurai.

VENUE OF THE STUDY

1. Institute of Anatomy, Madurai Medical College, Madurai.
2. Department of Forensic Medicine, Madurai Medical College, Madurai.

SAMPLE OF THE STUDY (FIG:1)

50 human appendix specimens, of which 35 specimens were collected from the postmortem bodies and the remaining specimens from the dissection room cadavers.

AGE DISTRIBUTION

Age Group	No. of Male	No. of Female
0-20 Yrs	3	4
20-40 Yrs	14	5
40-60 Yrs	14	3
Above 60 Yrs	4	3
Total	35	15

Specimens belonged to the age group between 10 – 80 years. The age distribution ranged between 10 – 80 years in male and between 16 to 63 years in female.

1. Between 0 – 20 yrs/ 7 specimens. (male 3, female 4)
2. Between 21 – 40 yrs, 29 specimens (male 14, female 5)
3. Between 41 – 60 yrs, 17 specimens (male 14, female 3)
4. Above 60 yrs, 7 specimens (male 4, female 3)

METHODS

1. Manual dissection was done in 15 cadavers in the dissection room and 25 specimens from the post mortem bodies.
2. Indian Ink was injected in five of the post mortem appendix specimens to study the arterial pattern of appendix.
3. Lead oxide was injected in five post mortem specimens and manual dissection was done.

1. MANUAL DISSECTION METHOD

a.GROSS DISSECTION METHOD DURING POST MORTEM:-

The abdominal cavity of the postmortem body was opened by median incision from xiphoid process to pubic symphysis. The appendix was identified without disturbing the other contents, the position of appendix was notified and photographed.

Then two ligatures were applied, one in the ascending colon 20cms from the ileocolic junction and another one in the terminal ileum, 5cms from the ileocaecal junction. The appendix and caecum were removed as enmass.

The collected specimens were preserved in 10% formalin for 15 days.

B. GROSS DISSECTION METHOD – IN THE CADAVERS

The abdomen was opened by the following incisions:-

1. A vertical incision was made from the xiphoid process to public symphysis.
2. A horizontal incision was made connecting the anterior superior ilac spine to the midline. The anterior abdominal wall was opened layer by layer. The appendix was indentified. The specimens numbered serially from 1 to 50.

The following observations were studied:-

(a) REGION OCCUPIED BY THE APPENDIX

Position of appendix in relation to abdominal regions and its relations to the vicera corresponding to the varying positions occupied was studied.

(b) POSITION OF THE APPENDICULAR ORIFICE

The position of appendicular orifice was noted in relation to the caecal walls, ileo-caecal orifice and spino umbilical line. (Mac Burneys point)

(c) DIRECTION OF THE TIP AND POSITION OF THE SHAFT OF APPENDIX

The direction of the tip of the appendix and the position of shaft was noted.

(d). LENGTH OF THE APPENDIX

The length of the appendix was measured with the help of a measuring scale. The measurement was done in centimeters.

(e) DIAMETER OF THE APPENDIX

The transverse diameter was measured at three levels. One at its base, the second one at the middle and the third towards the tip.

The measurement was taken in millimeters with the help of vernier caliper.

(f). NATURE OF THE MESO APPENDIX

The extend of the mesoappendix was noted in relation to the appendix.

(g). ARTERIAL PATTERN OF THE APPENDIX

The appendicular artery was studied for

1. Number of appendicular arteries.
2. Origin
3. Branching pattern and communications

II. INDIAN INK INJECTION METHOD

Five of the post morterm specimens were washed well and Indian ink was injected into the ileocolic artery. The open end of the ileo-colic artery was tied with thread and preserved in 10% formalin for 5 days. Manual dissection was done to study the arterial pattern.

III. LEAD OXIDE INJECTION METHOD

The lead oxide was injected into the ileo-colic artery preserved in 10% formalin and then routine manual dissection was done.

The observations made from the study were tabulated and statistically analysed.

The results were compared with earlier reports.

OBSERVATIONS

The following observations were made from the study of 50 specimens of human appendix under different methods.

(a) REGION OCCUPIED BY THSE APPENDIX

In the present study it has been observed that the appendix occupied the right iliac fossa in 32 cases (64%). It was in Pelvic region in 12 cases (24%), in the inguinal region in 1case (2%) and in the umbilical region in 5cases (10%).

(b) POSITION OF OSTIUM (OR) BASE OF THE APPENDIX (FIG:2)

In the present study the appendicular orifices were present in the posteromedial wall of caecum in 26 cases (52%), in middle of the lower pole of caecum in 19 cases (38%) and in the anterior wall of caecum in 5 cases (10%).

(c) DISTANCE BETWEEN THE ILEO CAECAL JUNCTION AND THE APPENDICULAR ORIFICE

In the present study, the distance between the ileo caecal junction and the appendicular orifice was ranging between 15 to

35mms. The average distance was 23.7mm. The longest distance being 35mm and the shortest was 15mm.

(d) RELATION BETWEEN THE APPENDICULAR ORIFICE AND MC BURNEY'S POINT

In this work it is observed that the orifice was within 5cms medial to the McBurney's point in 24cases (48%), within 10cms medial to McBurney's point in 8cases (16%), lateral to the McBurney's point in 9cases (18%) and in the McBurney's point in 9cases (18%).

(e) DIRECTION OF THE TIP AND POSITION OF THE SHAFT OF APPENDIX (FIG: 3,4,5,6 & 7)

Direction of the tip:-

Direction was vertically upwards in 32cases (64%), obliquely upwards in 5 cases (10%), and downwards in 13cases (26%).

Number of appendicular tips situated in 11'o clock position was 15cases (30%), 12'o clock position in 17cases (34%), 2'o clock position in 5cases (10%), 5'o clock position in 12 cases (24%) and 6'o clock position in 1case (2%).

Position of the shaft:-

In the present study it is retrocaecal in 20 specimens (40%), retocolic in 12 specimens (24%), pelvic in 12 specimens (24%), postileal

in 4 specimens (8%), preileal in 1 specimen (2%) and subcaecal in 1 specimen (2%).

(f) LENGTH OF THE APPENDIX (FIG : 8 & 9)

In the present study the longest appendix was 16cms. The shortest appendix noted was 1.5cms.

The average length of the appendix in male was 9.41cms and ranged between 14.3 to 1.5cms.

The average length of the appendix in female was 8.85cms and ranged between 16 to 4.2cms.

(g) DIAMETER OF THE APPENDIX

It is observed that the diameter of appendix ranged from 2 to 9mm.

The average diameter of appendix at the base was 5.61mms, at middle of the shaft was 5.68mms, at the tip was 5.30mms.

The average diameter of appendix in this study was 5.62mms.

(h) THE MESO APPENDIX

In the present study the meso appendix extended upto the tip of the appendix in 17cases (34%), failed to reach the tip in 33cases (66%).

(i) ARTERIAL PATTERN OF APPENDIX

In the present study 7 types of arterial pattern are observed.

TYPE I PATTERN:- (FIG : 10)

Observed in 13 specimens (26%, 11 male specimens 2 female specimens). The appendicular artery had its origin from the ileo colic as it approached the appendix it divided into 2 or 3 sub divisions.

TYPE II PATTERN:- (FIG : 11)

Observed in 9 specimens (18% 7 male and 2 female). The appendicular artery was from the ileo colic artery and divided immediately into 2 trunks which made free anastamosis with each other in the meso appendix.

TYPE III PATTERN:- (FIG : 12)

Observed in 2 specimens (4% 1 male and 1 female). The aapendicular atery originated from ileo colic artery and immediately trifurcated, with free anastamosis between the three divisions in the meso appendix.

TYPE IV PATTERN:- (FIG : 13)

Observed in 9 specimens (18% 7 male and 2 female). The appendicular artery was from the posterior caecal artery.

TYPE V PATTERN:- (FIG :14)

Observed in 9 specimens (18%, 4 male and 5 female). There were two appendicular arteries, one from the anterior caecal artery and another from posterior caecal artery.

TYPE VI PATTERN:- (FIG : 15)

Observed in 7 specimens (14%, 4 male and 3 female). There were two appendicular arteries, both from posterior caecal arteries.

TYPE VII PATTERN:- (FIG : 16)

Observed in 1 specimens (2%, 1 male). There were two appendicular arteries, both from anterior caecal artery.

DISCUSSION

The morphology and arterial supply of vermiform appendix was studied in 50 cases of both males and females of different age groups.

(a) REGION OCCUPIED BY THE APPENDIX

TABLE I

AUTHOR	YEAR	RIF	PELVIC	UMBLICAL	INGUINAL
KARIM	1991	20%	54%	15%	11%
PRESENT STUDY	2006	64%	24%	10%	2%

Karim (1991) studied the regions occupied by the appendix and reported that the appendix was in Pelvic region in 54% of cases, umblical in 15%, right iliac in 20% and right inguinal in 11%.

In the present study the region occupied by the appendix was right iliac fossa in 64% (32 cases), Pelvic in 24% (12 cases), Inguinal in 2%(1 case) and umbilical in 10% (5 cases).

In the present study, the incidence of appendix situated in the right iliac fossa was more (64%) compare to the previous study (20%).

In the umbilical position of the appendix, the situations of the appendix was in the right infracolic space. So this position may give rise to peritonitis of the infracolic peritoneal spaces.

In the western race the common position of the appendix had been pelvic and in South Indian race it was in right iliac fossa.

Appendicitis involving appendix situated in the Inguinal position may be associated with ilio-psoas spasm with slight flexion deformity of the hip joint Later on, appendicular mass or abscess may give rise to psoas abscess.

(b) POSITION OF OSTIUM OR BASE OF THE APPENDIX (FIG : 2)

TABLE II

AUTHOR	YEAR	MIDDLE OF LOWER POLE OF CAECUM	POTERO MEDIAL WALL OF CAECUM	ANTERIOR WALL OF CAECUM	LATERAL WALL OF CAEXUM
DELIC	2002	32%	48%	10%	10%
PRESENT STUDY	2006	38%	52%	10%	-

Delic's (2002) studied the ostium and reported that the ostium was situated in middle of the lower pole of caecum in 32%, in the postero medial wall of caecum in 48% in the lateral wall of ceacum in 10% and in the anterior wall of caecum in 10%.

In the present study, The position of ostium was in the postero medial wall of caecum in 52%, middle of the lower pole of caecum in 38% and in the anterior wall of caecum in 10%.

So when compared to the previous study, their is higher incidence of the ostium in the postero medial wall.

In appendicitis, the surgeons usually elicit tenderness at the McBurney's point. In the above noted varied positions, the point of maximum tenderness also may vary.

(c) DISTANCE BETWEEN THE ILEO CAECAL JUNCTION AND THE APPENDICULAR ORIFICE

Ndoye, Dia (2005) observed that the distance between the ostium of appendix and the ilieo caecal junction varied between 16 to 40mms with average distance of 24.2mm.

In the present study, the distance between ostium of the appendix and the ilieo caecal junction ranged between 15 to 35mms with average distance of 24mm.

This observation almost coincides with the previous study

(d) RELATION BETWEEN THE APPENDICULAR ORIFICE AND MC BURNEY'S POINT

TABLE III

AUTHOR	BASE SITUATED IN THE MC BURNEY'S POINT	BASE SITUATED MEDIAL TO AND WITH IN 5CMS OF MC BURNEY'S POINT	BASE SITUATED MEDIAL TO AND WITH IN 10CMS OF MC BURNEY'S POINT	BASE SITUATED LATERAL TO MC BURNEY'S POINT
RAMSDEN] (1993)	0	75%	20%	5%
PRESENT STUDY	18%	48%	16%	18%

Ramsden (1993) had reported that the base of the appendix was medial to and within 5cms of McBurney's point in 75% of cases, medial to and within 10cms of McBurney's point in 20% and lateral to the McBurney's in 5%.

In the present study, the base of appendix is situated medial to and within 5cms of McBurney'a point in 48% (24cases), medial to and within 10cms of McBurney's point in 16% (8cases), lateral to McBurney's point in 18% (9cases) and in the McBurney's point in 18% (9cases).

So in the present study, the incidence of the position of base or ostium medial and within 5cms of McBurney's point is less when compared to previous study.

It is significant to note that McBurney's tenderness may be shifted to other positions depending upon the position of the base of the appendix.

(e) DIRECTION OF THE TIP AND POSITION OF THE SHAFT OF APPENDIX

(i) Retrocaecal and Retrocolic position:- (FIG : 3 & 9)

As per the study of Gladstone and Wakeley (1923), it was retrocaecal and retrocolic in 69.2%.

Donald Collins observed retrocaecal and retrocolic positions in 21.5%, Wakeley (1933) in 65.28%, Gopalrao (1979) in 82%, Ajmani (1983) in 68%, Bakheit (1997) in 58.3%, Gopalipour (2003) in 32.4%.

Delic and Sadkodic (2002) observed retrocaecal position in 38%, retrocoic poisition in 13%, Bailey and Love (2005) retrocaecal in 42% and retrocolic 31%.

In the present study the retrocaecal position is observed in 40% of cases (male 28%, female 12%) and the retrocolic position in 24% of cases (male 18%, female 6%) and combinedly the retrocaecal and retrocolic position in 64% of cases.

TABLE IV

POSITION OF THE APPENDIX

AUTHOR	RETROCAECAL	RETROCOLIC	PELVIC	PREILEAL	POSTILEAL	SUBCAECAL
GLADSTONE(1923)	69.2		27.5	0.9	0.5	1.86
COLLINS (1930)	29.5		50	1	0.71	1.24
WAKELEY (1933)	65.28		31.01	1	0.4	2.26
GOPALRAO (1979)	40.3		43.6			
AJMANI (1983)	68		20	1	10	
BAKHEIT (1997)	58.3		21.7	2	10	
DELIC (2002)	38	13	26	3		8
HAROLDELLIS (2002)	75		18	2.5	2.5	2
GOPALIPOUR (2003)	32.4		33.3	18.8	2.6	12.8
BAILEY AND LOVE (2005)	42	31	25	1	1	
PRESENT STUDY	40	24	24	2	8	2

This observation almost coincides with observation made by wakeley (65.28%), Gladstone (69%) and A L Ajmani (68%).

The significance of the retrocolic and retrocaecal position is that in appendicitis, the inflammatory appendicular mass is always retroperitoneal and never infect the general peritoneal cavity.

In retrocolic position, since it is behind the ascending colon, there is difficulty in diagnosis and the beginning of the treatment is usually in the late stage only.

(ii) PELVIC POSITION OF THE APPENDIX (FIG : 4)

The pelvic position was observed by Gladstone (1923) in 27.5% of cases, Wakeley (1932) in 31.01.%, Gopalrao (1979) in 43.6%, A L Ajmani (1983) in 20%, Bakheit (1997) in 26%, Delic (2002) in 26%, Harold Ellis (2002) in 18%, Gopalipour (2003) in 33.3%, Bailey and Love (2005) in 25% of cases.

In the present study, it is Pelvic in position in 24% of cases which almost coincides with previous observations made by Gladstone (27.5%), A L Ajmani (20%), Bakheit (26%0, Delic (26%) and Bailey and Love (26%).

In Pelvic position, appendicitis may be complicated with pelvic peritonitis. Since the appendix is directed towards the rectum it may give rise to pararectal infection.

In females, inflamed appendix situated in Pelvic position, there is a difficulty to differentiate appendicitis from oopheritis and salphingitis or Pelvic appendicitis may be associated with the above mentioned conditions.

(iii) POST ILEAL POSITION OF THE APPENDIX (FIG : 6)

The post ileal position of the appendix was observed by Gladstone (1923) in 0.5%, Donald Collins (1931) in 0.71%, Wakeley (1933) in 0.4%, Ajmani (1983) in 10%, Bakheit, Warillie (1997) in 10%, Harold Ellis (2002) in 2.5%, Gopalipour, Arya (2003) in 2.6%, Bailley and Love (2005) in 1% of cases.

In the present study the post ileal position is observed in 8% of cases which almost coincides with previous observations made by Ajmani (10%) and Bakheit (10%).

In post ileal position, usually the appendix is between the two layers of the mesentry. So appendicitis is usually associated with a mesenteric abscess, which may infect the large number of mesenteric lymph nodes, leading to lymphadenitis. Later on it leads to arteritis, subsequently it may produces superior mesenteric vascular occlusion and fatal complications of gangrene of the small intestine. So in general it is usually considered as the most dangerous position of the appendix.

Arriving at a diagnosis in postileal position usually takes much time. By then, all the complications will have developed.

(iv) PRE ILEAL POSITION OF THE APPENDIX (FIG : 5)

The preileal position of appendix was observed by Gladstone (1923) in 0.9%, Donald Collins (1931) in 1%, Wakeley (1933) in 1%, Ajmani (1983) in 1%, Bakheilt (1997) in 2%, Harold Ellis (2002) in 2.5%, Gopalipour, Arya (2003) in 2.6%, Bailey and Love (2005) in 1% of cases.

In the present study, the pre ileal position is observed in 2% of cases which almost coincides with previous observations made by Bakheit 2%, Harold Ellis (2.5%) and Gopalipour (2.6%).

In pre ileal position, since it is situated anterior to the terminal ileum and mesentry it may lead to infection of the right infra colic space and abscess.

(v) SUBCAECAL POSITION OF THE APPENDIX (FIG 7)

The Subcaecal position of appendix was observed by Gladstone (1923) in 1.86%, Donald Collins (1931) in 1.24%, Wakeley (1933) in 2.26%, Delic (2002) in 8%, Harold Ellis (2002) in 2%, Gopalipour and Arya (2003) in 12.8% of cases.

In the present study, the subcaecal position is observed in 2% of cases which almost coincides with the previous observations made by Gladstone (1.86%) and Harold Ellis (2%).

In subcaecal position, the position of the abscess is usually immediately above the lateral 1/3rd of the inguinal ligament and so the absecess is mostly inguinal in position.

In the present study, the ectopic appendix, appendix duplex, appendicular agensis are not observed.

(f) LENGTH OF THE APPENDIX (FIG 8 & 9)

TABLE V

AUTHOR	LENGTH (in cms)
GLADSTONE (1892)	8
BEYERT (1893)	8.25
BERRY (1893)	8.3
HOLMER (1904)	6 to 10
KELLY (1905)	9 to 10
MACPHIL (1917)	9.9
BRADY (1979)	11.9 (female) 12 (male)
AJMANI (1983)	8.7 (female) 9.5 (male)
BAILEY and LOVE (2005)	5 to 7
NDOYE (2005)	10.64

The length of the appendix as reported by Collins (1931) was 8.21cms, by Glad stone (1892) as 8cms, by Beyert (1983) as 8.25cms, by Berry (1893) as 8.3cms, by Holmer (1904) as 6 to 10 cms, by Kelly, Hurden (1905) 9 to 10 cms, by Katezarski, Gopalrao (1979) as 12cms in male and 11.9cms in female, by Ajmani (1983) as 9.5cms in male and 8.7cms in female, by Gopalipour (2003) as 6.61cms in male and 6.06cms in female.

In the present study the average length of appendix in male is 9.41 cms and in female is 8.8cms which almost coincides with the previous observations made by Ajmani in North Indian population.

In the present study, the longest appendix is 16cms. The infection of the long appendix may be associated with infection of the other organs to which it comes in contact.

The shortest appendix in the present work is 1.5cms in length. It may not be associated with complications and infections to adjacent organs when compared to long appendix.

(g) DIAMETER OF THE APPENDIX

TABLE VI

AUTHOR	DIAMETER (in mm)
DEA VER (1913)	5
MACPHIL (1917)	6
ARTHUR ROBINSON	6
ROYSTER (1927)	6
RETTEN BACHER (2001)	6

The diameter of appendix was observed by Deaver (1913) at the base as 5mms, by Macphil (1917) as 6mms, by Arthur Robinson (1923) as 6mm, by Royster (1927) as 6mms, and Retten Bacher (2001) as 6mm.

In the present study the average diameter of appendix is 5.62mms which almost coincides with previous study.

As per the ultra sonographic study by Retten Bacher, he has explained that a diameter of more than 6mm at the base of the appendix indicated appendicitis. But in the present study since it is made in the cadavers and in post mortem bodies, the above mentioned facts was not able to be confirmed.

(h) MESOAPPENDIX

TABLE VII

AUTHOR	MESOAPPENDIX EXTENDING UPTO THE TIP OF THE APPENDIX	MESOAPPENDIX NOT EXTENDING UPTO THE TIP OF THE APPENDIX
GOPALIPOUR	65.8%	34.2%
PRESENT STUDY	66%	34%

Gopalipour (2003) had reported that the mesoappendix is not extending upto the tip of the appendix in 65.8%and was upto the tip in 34.2%.

In the present study, the mesoappendix did not reach the tip of the appendix in 66% and upto the tip in 34% which almost coincides with the previous study.

It is significant in that, if the mesoappendix failed to reach the tip, the appendicular artery is usually present on the tunica of the appendix leading to early arteritis.

(I) ARTERIAL PATTERN OF THE APPENDIX (FIG : 10 – 16)

TABLE VIII

AUTHOR	TYPE I	TYPE II	TYPE III	TYPE IV	TYPE V	TYPE VI	TYPE VII
SHAH	31.7%	18.3%	1.7%	18.3%	20%	8.3%	1.7%
PRESENT STUDY	26%	18%	4%	18%	18%	14%	2%

Shah and Shah classified the arterial pattern into seven types and observed that the type I pattern occurred in 31.7% of cases, type II pattern in 18.3%, type III pattern in 1.7%, type iv pattern in 18.3%, type V in 20%, type VI in 8.3% and type VII in 1.7% of cases.

In the present study, the type I pattern is observed in 26%, type II pattern in 18%, type III pattern in 4%, type IV pattern in 18%, type V pattern in 18%, type VI pattern in 14% and type VII pattern in 2% of cases which almost coincides with the previous study except there is higher incidence of type III, IV pattern in this study.

In I, II, III type of arterial patterns during appendicectomy just ligation of the appendicular artery close to its origin from ileo colic artery is sufficient.

The appendicular artery was from posterior caecal artery in the IV pattern and in such pattern during appendicectomy it has to be ligated at its origin from posterior caecal.

In pattern V, there were two appendicular arteries and so during surgery we have to trace their origin of both upto anterior caecal and posterior caecal arteries. Then double ligation and divisions is required in these cases .

In pattern VI and VII again double ligation and division in relation to its origin either to posterior caecal or anterior caecal is required during surgery.

CONCLUSION

The present study of the appendix in relation to the position, length, diameter and arterial supply are compared with the earlier reports.

It is observed that the appendix may occupy varying positions and so apart from the typical presentation of the appendicular mass in the right iliac fossa, it may be present in the inguinal or preileal, or infra colic or retrocolic regions. Usually the appendicular abscess is localized, but it may infect the general peritoneal cavity if it is umbilical in position. In the present study, the appendix occupied the umbilical region in 10%.

The maximum tenderness, usually it is present in the McBurney's point. But the orifice of appendix in the present study is varying in position, for example in the posteromedial wall, in the lower pole of the caecum. Because of the varying position, the point of tenderness also may be elicited at varying position.

It is observed that retrocaecal position is of usual occurrence in south Indian races and so the appendicular abscess is localized, usually it diagnosed without much difficulty. If retrocolic, it is behind the ascending colon and it may be time consuming to come to a definite

diagnosis. If it is pelvic in position appendicitis is usually associated with pelvic peritonitis. It may present as a pararectal abscess or may mimic a pararectal abscess. In females it leads to pelvic peritonitis of the posterior compartment and may present as an abscess in the douglass pouch. If the appendix comes in to contact with ovary or fallopian tube, appendicitis may be complicated with salphingitis and oopheritis or a mere pelvic position may mimic salphingitis or oopheritis and difficulties may be encountered to come to a definite diagnosis.

In the present study the postileal position was observed in 10% of cases. In postileal position the tip and the shaft of the appendix is present between the two layers of the mesentry at its root. So it may be present as retroperitonial abscess along the root of the mesentry. If the length of the appendix is longer it is within the two layers which causes lymphadenitis with lymphatic stasis, compression to the veins with venous stasis, the stasis of both giving rise to inflammatory oedema in the mesentry and in the small intestine.

Inflamatory arteritis due to infection spreading from the lymphnodes or compression by the enlarged lymphnodes leading to thrombus formation in the vasarecta or in the arcades and if massive in the superior mesenteric artery itself leading to either localised ischemia to

a particular region or whole of the gut supplied by the superior mesenteric artery finally leading to the gangrene of the bowl.

The study of the diameter of the appendix is important in that, if the diameter in the ultrasonographic study is more than 6mm it is considered as a sign of appendicitis.

The arterial pattern gains importance in relation to the ligation and division of the arteries. If the artery is directly in contact with the wall of the appendix it may be subjected to earlier periarteritis and thrombus formation. But if it is within the layers of the mesoappendix, the involvement of the artery may be late.

So it is concluded that apart from the typical presentation of the appendix as described in the anatomical text books, it is observed that a position which is rare in some race becomes trivial in other races. We could not exclude that there are rarities and any presentaion must be given equal importance in order to prevent later complications.

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FIGURE -1 FIFTY APPENDIX SPECIMENS OF THE PRESENT STUDY

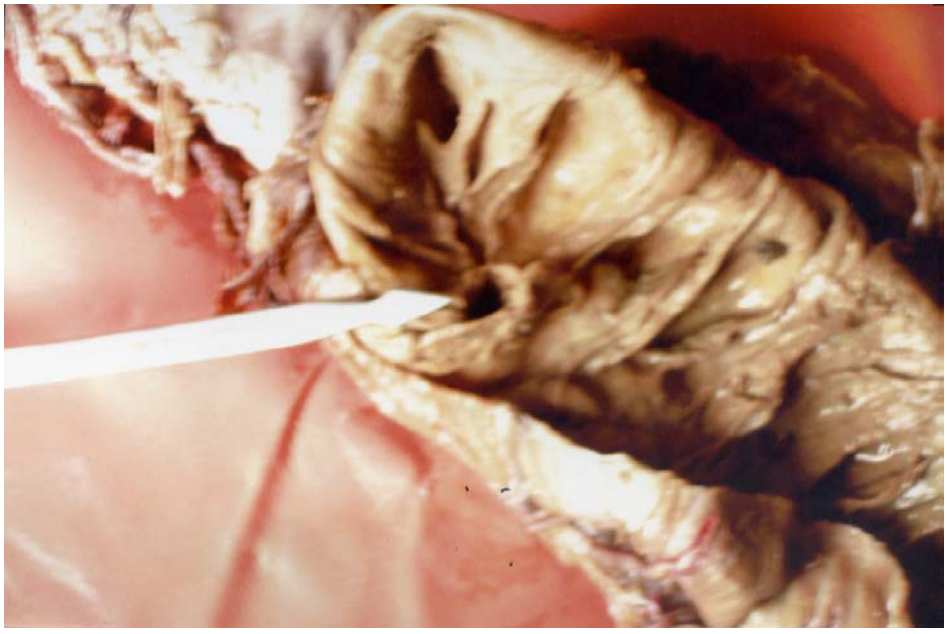


FIGURE – 2 APPENDICULAR ORIFICE SITUATED IN THE POSTERO MEDIAL WALL OF CAECUM

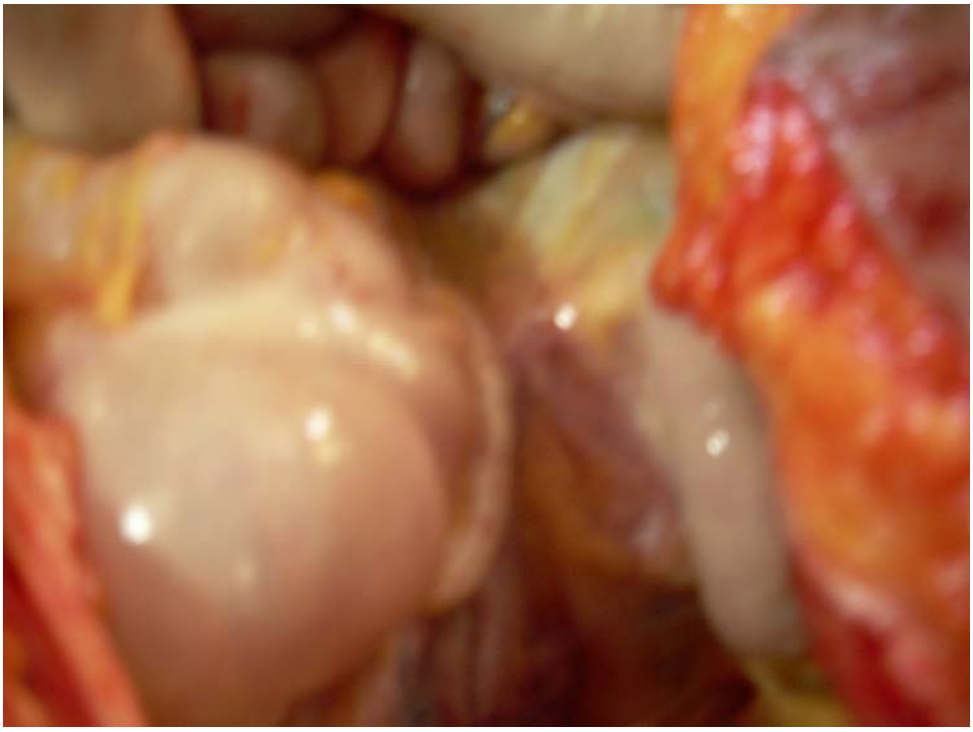


FIGURE -3 RETEROCAECAL POSITION OF THE APPENDIX

FIGURE – 4 PELVIC POSITION OF THE APPENDIX

FIGURE – 5 PRE ILEAL POSITION OF THE APPENDIX

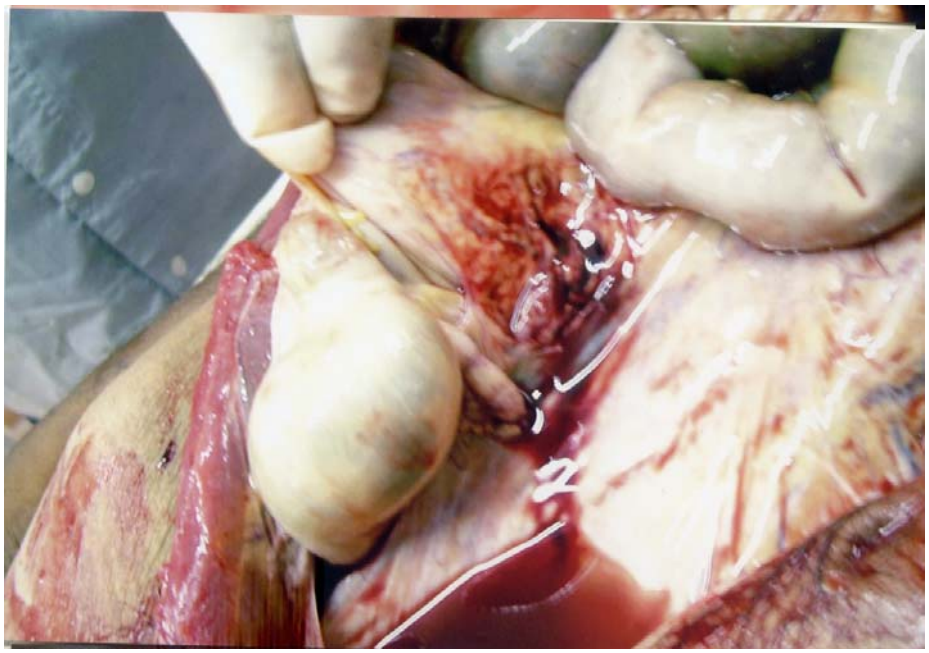


FIGURE – 6 POST ILEAL POSITION OF THE APPENDIX

FIGURE – 7 SUB CAECAL POSITION OF THE APPENDIX

FIGURE – 8 THE SHORTEST APPENDIX OF THE PRESENT STUDY - 1.5 CMS IN LENGTH

FIGURE – 9 THE LONGEST APPENDIX OF THE PRESENT STUDY – 16 CMS IN LENGTH , RETEROCOLIC IN POSITION

FIGURE – 10 TYPE I ARTERIAL PATTERN OF THE APPENDIX

FIGURE – 11 TYPE II ARTERIAL PATTERN OF THE APPENDIX

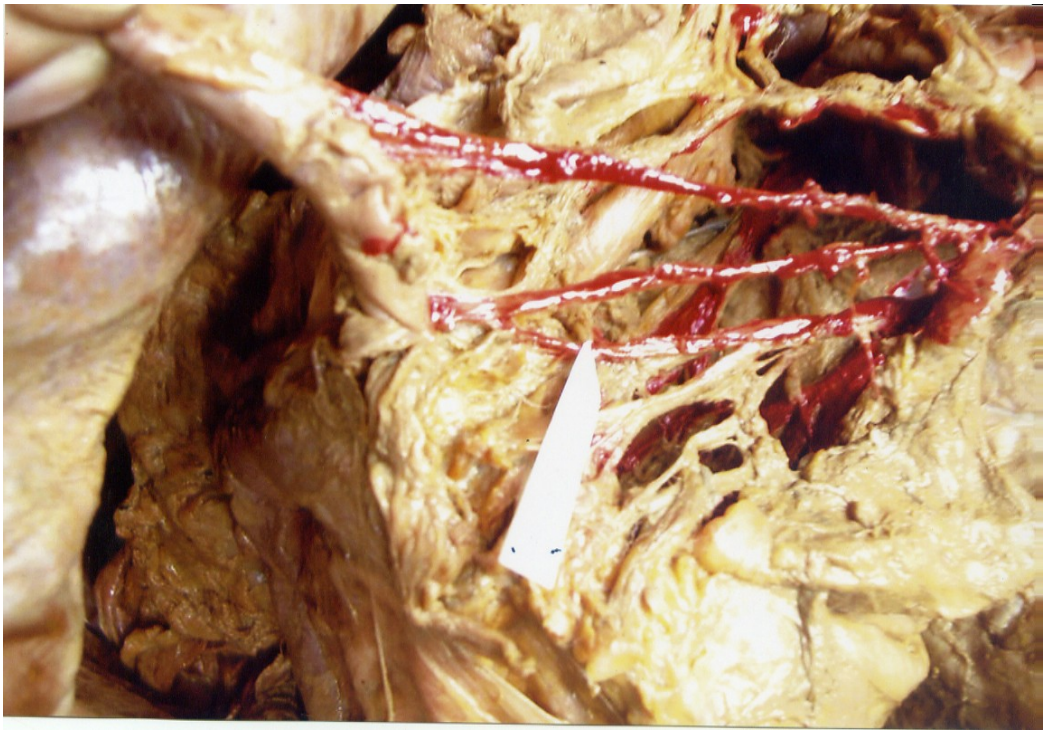


FIGURE – 12 TYPE III ARTERIAL PATTERN OF THE APPENDIX

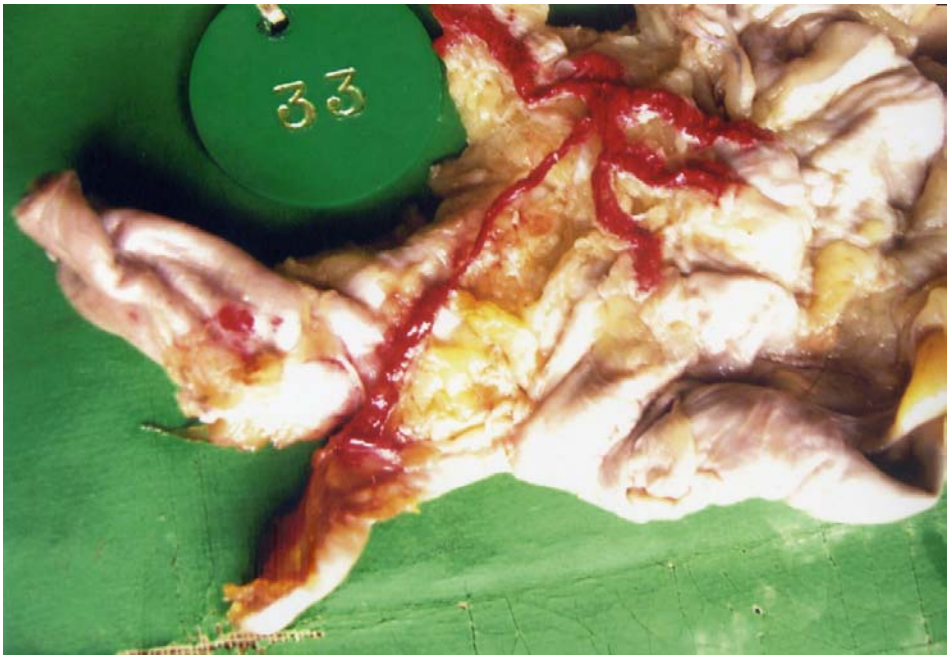


FIGURE – 13 TYPE IV ARTERIAL PATTERN OF THE APPENDIX

FIGURE – 14 TYPE V ARTERIAL PATTERN OF THE APPENDIX

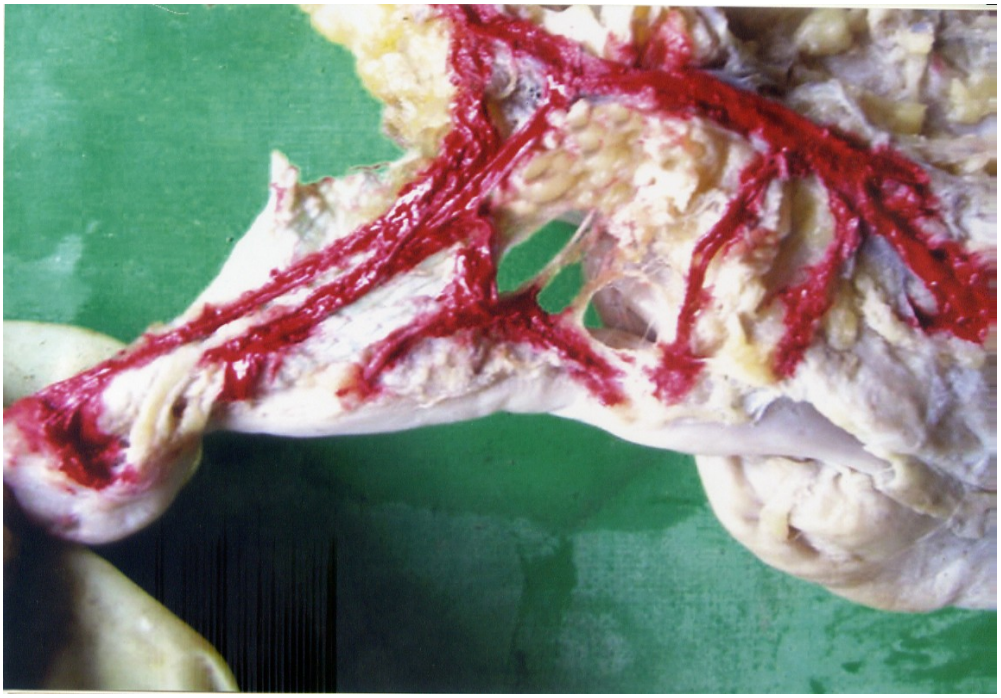


FIGURE – 15 TYPE VI ARTERIAL PATTERN OF THE APPENDIX

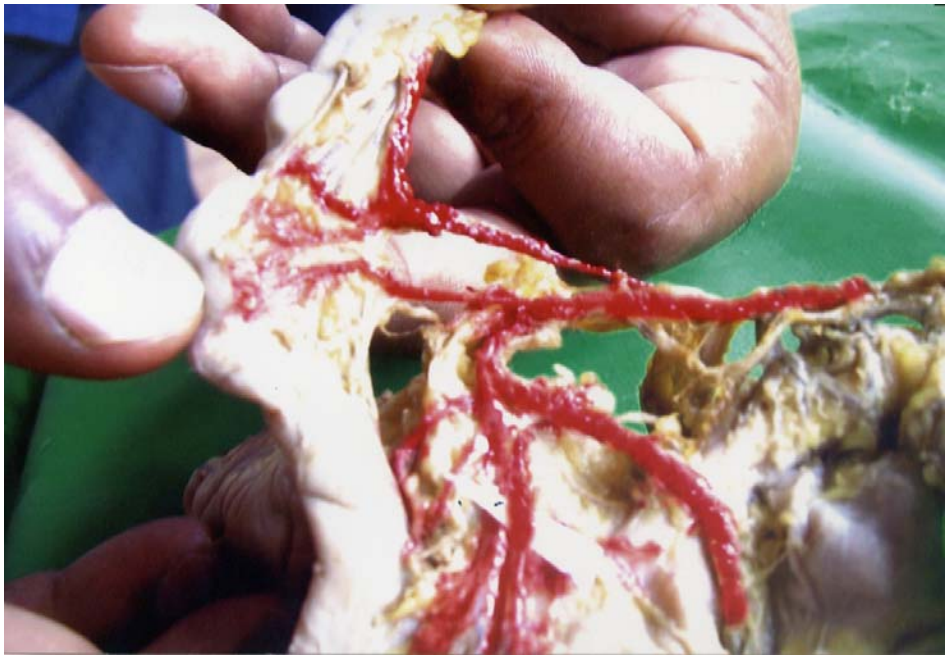
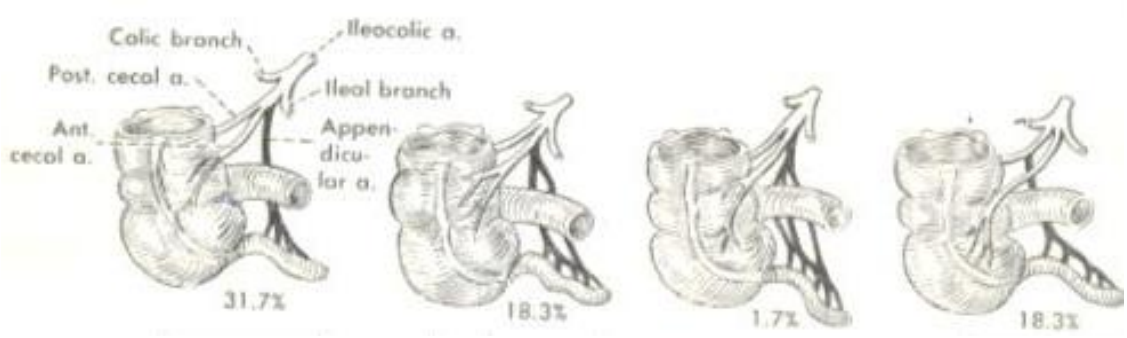


FIGURE – 16 TYPE VII ARTERIAL PATTERN OF THE APPENDIX

ARTERIAL PATTERN OF THE APPENDIX AS DESCRIBED BY SHAH & SHAH



Type - I	Type - II	Type - III	Type - IV

Type - V	Type - VI	Type - VII

TABLE I

REGIONS OCCUPIED BY THE APPENDIX

Sl. No.	Sex	Age in Yrs	Region occupied by the appendix
01.	F	25	Right iliac fossa
02.	F	70	Right iliac fossa
03	M	33	Pelvic
04	M	15	Right iliac fossa
05	M	38	Right iliac fossa
06	M	25	Right iliac fossa
07	F	30	Right iliac fossa
08	M	40	pelvic
09	M	29	Umblical
10	M	80	Pelvic
11	F	62	pelvic
12	M	45	Right iliac fossa
13	M	65	Right iliac fossa
14	F	18	Inguinal
15	F	63	Right iliac fossa
16	M	39	Right iliac fossa
17	M	40	Pelvic
18	M	30	Umblical
19	M	48	Pelvic
20	M	48	Umblical
21	F	35	Right iliac fossa
22	M	38	Right iliac fossa
23	F	40	Pelvic
24	M	18	Umblical
25	F	35	Right iliac fossa
26	M	46	Right iliac fossa
27	M	49	Right iliac fossa
28	F	45	pelvic

29	**M**	**35**	**Right iliac fossa**
30	**M**	**50**	**Right iliac fossa**
31	**M**	**42**	**Right iliac fossa**
32	**F**	**19**	**Right iliac fossa**
33	**M**	**48**	**pelvic**
34	**F**	**52**	**Right iliac fossa**
35	**M**	**48**	**Right iliac fossa**
36	**M**	**38**	**Right iliac fossa**
37	**M**	**58**	**Right iliac fossa**
38	**M**	**59**	**Right iliac fossa**
39	**M**	**43**	**Right iliac fossa**
40	**F**	**18**	**Umblical**
41	**M**	**56**	**Right iliac fossa**
42	**F**	**17**	**pelvic**
43	**M**	**52**	**Right iliac fossa**
44	**M**	**70**	**Right iliac fossa**
45	**M**	**10**	**Pelvic**
46	**F**	**48**	**rightiliacfossa**
47	**M**	**80**	**Right iliac fossa**
48	**M**	**32**	**Right iliac fossa**
49	**M**	**37**	**Pelvic**
50	**M**	**40**	**Right iliac fossa**

TABLE II

POSITION OF THE BASE OF APPENDIX

Sl. No.	Sex	Age in Yrs	Position of base of appendix(in relation to caecal wall)	Distance between the ilio-caecal orifies & appendicular orifies	Position of appendicular orifice in relation to McBurney's point
01.	F	25	Lower pole	20	5cms medial
02.	F	70	Postero medial	24	3cms lateral
03	M	33	Lower pole	28	4cms medial
04	M	15	Postero medial	30	3.5cms medial
05	M	38	Postero medial	15	4.6cms medial
06	M	25	Postero medial	19	8cms medial
07	F	30	Lower pole	16	2.8cms medial
08	M	40	Lower pole	25	1cms medial
09	M	29	Anterior	29	Corresponds
10	M	80	Lower pole	35	5cms medial
11	F	62	Postero medial	25	7cms lateral
12	M	45	Postero medial	27	corresponds
13	M	65	Lower pole	23	2.5cms medial
14	F	18	Anterior wall	22	5 cms lateral
15	F	63	Postero medial	18	8cms medial
16	M	39	Postero medial	16	3.8cms medial
17	M	40	Lower pole	26	4.5cms medial
18	M	30	Anterior wall	34	1cms lateral
19	M	48	Lower pole	28	6cms medial
20	M	48	Anterior wall	29	1cms medial
21	F	35	Postero medial	24	8cms medial
22	M	38	Postero medial	24	3cms lateral
23	F	40	Lower pole	20	2cms medial
24	M	18	Postero medial	18	coresponds
25	F	35	Postero medial	18	4.2cms medial

26	**M**	**46**	**Lower pole**	**15**	**corresponds**
27	**M**	**49**	**Postero medial**	**19**	**2.2cms medial**
28	**F**	**45**	**Postero medial**	**24**	**1.3cms medial**
29	**M**	**35**	**Postero medial**	**24**	**8cms medial**
30	**M**	**50**	**Postero medial**	**24**	**3cms lateral**
31	**M**	**42**	**Postero medial**	**25**	**corresponds**
32	**F**	**19**	**Postero medial**	**29**	**2.5cms medial**
33	**M**	**48**	**Lower pole**	**35**	**3.4cms medial**
34	**F**	**52**	**Lower pole**	**18**	**4cms medial**
35	**M**	**48**	**Postero medial**	**25**	**2cms lateral**
36	**M**	**38**	**Lower pole**	**26**	**6cms medial**
37	**M**	**58**	**Postero medial**	**29**	**3.2cms medial**
38	**M**	**59**	**Postero medial**	**17**	**corresponds**
39	**M**	**43**	**Lower pole**	**29**	**3cms medial**
40	**F**	**18**	**Anterior wall**	**34**	**coresponds**
41	**M**	**56**	**Postero medial**	**30**	**5cms lateral**
42	**F**	**17**	**Lower pole**	**29**	**6cms medial**
43	**M**	**52**	**Postero medial**	**16**	**2.3cms medial**
44	**M**	**70**	**Lower pole**	**29**	**4.cms medial**
45	**M**	**10**	**Lower pole**	**20**	**8cms medial**
46	**F**	**48**	**Postero medial**	**24**	**coresponds**
47	**M**	**80**	**Postero medial**	**25**	**1.9cms medial**
48	**M**	**32**	**Lower pole**	**26**	**corresponds**
49	**M**	**37**	**Lower pole**	**24**	**2cms lateral**
50	**M**	**40**	**Postero medial**	**24**	**3cms medial**

TABLE III

POSITION OF THE TIP AND SHAFT OF THE APPENDIX

Sl. No.	Sex	Age in Yrs	Direction of tip of the appendix	Clock position of tip	Position of Appendix
01.	F	25	Upwards	11'o clock	Retrocolic
02.	F	70	Upwards	12'o clock	Retrocaecal
03	M	33	Downwards	5'o clock	Pelvic
04	M	15	Upwards	12'o clock	Retrocolic
05	M	38	Upwards	11'o clock	Retrocolic
06	M	25	Upwards	11'o clock	Retrocaecal
07	F	30	Upwards	11'o clock	Retrocolic
08	M	40	Downwards	5'o clock	Pelvic
09	M	29	Obliquely	2'o clock	Postileal
10	M	80	Downwards	5'o clock	Pelvic
11	F	62	Downwards	5'o clock	Pelvic
12	M	45	Upwards	12'o clock	Retrocaecal
13	M	65	Upwards	11'o clock	Retrocaecal
14	F	18	Downwards	5 'o clock	Pelvic
15	F	63	Upwards	11'o clock	Retrocaecal
16	M	39	Upwards	11'o clock	Retrocolic
17	M	40	Downwards	5'o clock	Pelvic
18	M	30	Oblique	2'o clock	Postileal
19	M	48	Downwards	5'o clock	Pelvic
20	M	48	Oblique	2' O clcok	Preileal
21	F	35	Upwards	12'o Clock	Retrocaecal
22	M	38	Upwards	11'o clock	Retrocolic
23	F	40	Downwards	5'o clock	Pelvic
24	M	18	Oblique	2'o clock	Postileal
25	F	35	Upwards	11'o clock	Retrocaecal
26	M	46	Upwards	12'o clock	Retrocaecal
27	M	49	Upwards	11'o clock	Retrocaecal
28	F	45	Downwards	5'o clock	Pelvic

29	**M**	**35**	**Upwards**	**11’o clock**	**Retrocolic**
30	**M**	**50**	**Upwards**	**11’o clock**	**Retrocaecal**
31	**M**	**42**	**Upwards**	**11;o clock**	**Retrocolic**
32	**F**	**19**	**Upwards**	**12’o clock**	**Retrocolic**
33	**M**	**48**	**Downwards**	**5’o clock**	**Pelvic**
34	**F**	**52**	**Upwards**	**12’o clock**	**Retrocaecal**
35	**M**	**48**	**Upwards**	**12’o clock**	**Retrocaecal**
36	**M**	**38**	**Upwards**	**12’o clock**	**Retrocolic**
37	**M**	**58**	**Upwards**	**12’o clock**	**Retrocaecal**
38	**M**	**59**	**Upwards**	**12’o clock**	**Retrocaecal**
39	**M**	**43**	**Upwards**	**12’o clock**	**Retrocaecal**
40	**F**	**18**	**Upwards**	**12’o clock**	**Retrocaecal**
41	**M**	**56**	**Upwards**	**12’o clock**	**Retrocolic**
42	**F**	**17**	**Downwards**	**5;o clock**	**Pelvic**
43	**M**	**52**	**Upwards**	**11’o clock**	**Retrocaecal**
44	**M**	**70**	**Upwards**	**11’o clock**	**Retrocaecal**
45	**M**	**10**	**Downwards**	**6’o clock**	**Subcaecal**
46	**F**	**48**	**Oblique**	**2’o clock**	**Postileal**
47	**M**	**80**	**Upwards**	**12’o clock**	**Retrocaecal**
48	**M**	**32**	**Upwards**	**12’o clcock**	**Retrocolic**
49	**M**	**37**	**Downwards**	**5’o clock**	**Pelvic**
50	**M**	**40**	**Upwards**	**12’o clock**	**Retrocaecal**

TABLE V

LENGTH OF THE APPENDIX

Sl. No.	Sex	Age Yrs	Length of Appen Dix In cms
01.	F	25	12.5
02.	F	70	7.5
03	M	33	9.2
04	M	15	14.3
05	M	38	10.5
06	M	25	8
07	F	30	9
08	M	40	9
09	M	29	9.3
10	M	80	1.5
11	F	40	8.1
12	M	45	5.2
13	M	65	4.5
14	F	18	16
15	F	63	8.3
16	M	39	7.5
17	M	40	8.3
18	M	30	8.2
19	M	48	6.2
20	M	48	4.3
21	F	35	9
22	M	38	10.2
23	F	40	8
24	M	18	14
25	F	35	8
26	M	46	8.2
27	M	49	9.5
28	F	45	8.5

29	**M**	**35**	**12**
30	**M**	**50**	**10**
31	**M**	**42**	**11**
32	**F**	**19**	**7.5**
33	**M**	**48**	**9**
34	**F**	**52**	**7**
35	**M**	**48**	**9**
36	**M**	**38**	**10**
37	**M**	**58**	**9**
38	**M**	**59**	**8**
39	**M**	**43**	**10**
40	**F**	**18**	**9**
41	**M**	**56**	**9.5**
42	**F**	**17**	**10.2**
43	**M**	**52**	**9.3**
44	**M**	**70**	**12**
45	**M**	**10**	**11.2**
46	**F**	**48**	**4.2**
47	**M**	**80**	**9**
48	**M**	**32**	**9**
49	**M**	**37**	**9**
50	**M**	**40**	**10**

TABLE VI
DIAMETER OF THE APPENDIX

Sl.No.	Sex	Age in Yrs	Diameter at the base of appendix (in millimeters)	Diameter at the middle of appendix (in millimeters)	Diameter at the tip of appendix (in millimeters)	Average diameter of appendix (in mm)
01	F	25	4	4	4	4
02	F	70	8.2	7.4	7.3	7.6
03	M	33	5.2	5.3	4.5	4.8
04	M	15	4	4	4	5
05	M	38	4.3	4.2	3.5	4
06	M	25	5	5	5	5
07	F	30	6.2	6.3	5.5	6
08	M	40	8	8	8	8
09	M	29	7.8	7.1	6	6.9
10	M	80	3	2.8	2.6	2.8
11	F	62	5.5	5.5	4	5
12	M	45	4	4	4	4
13	M	65	4.3	4.1	3.4	3.9
14	F	18	9	9	8.6	8.8
15	F	63	8.5	8	7.5	8
16	M	39	4	4	4	4
17	M	40	8.5	8	8	8.1
18	M	30	8	8	7..8	7.6
19	M	48	4.3	4.1	3.5	3.9
20	M	48	5	5	5	5
21	F	35	7.4	6.5	6.5	6.8
22	M	38	4	4	4	4
23	F	40	6	6	5.8	5.9
24	M	18	8.5	8	7.5	8
25	F	35	7	6.8	5.6	6.4
26	M	46	4	4.2	3.8	4
27	M	49	6	6	5.,9	5.9

28	F	45	7	7	6..8	6.9
29	M	35	6	6	5.3	5.7
30	M	50	5	5	5	5
31	M	42	6	5.8	5.7	5.8
32	F	19	7	6.8	6.8	6.8
33	M	48	6	5.8	5.6	6
34	F	52	3	3	3	3
35	M	48	5	5	4.5	4.8
36	M	38	6	6	6	6
37	M	58	3	3	3	3
38	M	59	6	5.7	5.7	5.8
39	M	43	4.2	4	3.8	4
40	F	18	6.3	6	5.7	6
41	M	56	6.5	6	5.2	7.7
42	F	17	6.4	5.4	5.4	5.7
43	M	52	4	4	4	4
44	M	70	5.8	4.5	4.5	4.9
45	M	10	4.5	4.2	3.4	4
46	F	48	6.2	6.2	5.6	6
47	M	80	3	3	3	3
48	M	32	5	5.6	4.3	5
49	M	37	4	4	4	4
50	M	40	5	4.8	4.2	4.6

TABLE VII

STUDY OF MESO APPENDIX

Sl. No.	Sex	Age in Yrs	Disposition of meso appendix	Length of appendix devoid of meso appendix
01.	F	25	Failed to reach the tip	1.5
02.	F	70	Reached the tip	
03	M	33	Failed to reach the tip	2
04	M	15	Failed to reach the tip	3.4
05	M	38	Failed to reach the tip	1.9
06	M	25	Reached the tip	
07	F	30	Reached the tip	
08	M	40	Failed to reach the tip	1.3
09	M	29	Reached the tip	
10	M	80	Reached the tip	
11	F	62	Failed to reach the tip	2.5
12	M	45	Reached the tip	
13	M	65	Reached the tip	
14	F	18	Failed to reach the tip	3.6
15	F	63	Failed to reach the tip	1.4
16	M	39	Failed to reach the tip	1.3
17	M	40	Failed to reach the tip	2.2
18	M	30	Failed to reach the tip	1.5
19	M	48	reached the tip	
20	M	48	Reached the tip	
21	F	35	Failed to reach the tip	1
22	M	38	Failed to reach the tip	1.2
23	F	40	reached the tip	
24	M	18	reached the tip	
25	F	35	Failed to reach the tip	0.8
26	M	46	Failed to reach the tip	1.2
27	M	49	Failed to reach the tip	1.8
28	F	45	Failed to reach the tip	1.2

29	**M**	**35**	**Failed to reach the tip**	**2.0**
30	**M**	**50**	**Failed to reach the tip**	**1.3**
31	**M**	**42**	**Failed to reach the tip**	**2.3**
32	**F**	**19**	**Failed to reach the tip**	**1.2**
33	**M**	**48**	**reached the tip**	
34	**F**	**52**	**Reached the tip**	
35	**M**	**48**	**Failed to reach the tip**	**1.8**
36	**M**	**38**	**Failed to reach the tip**	**2.1**
37	**M**	**58**	**Failed to reach the tip**	**1.8**
38	**M**	**59**	**Failed to reach the tip**	**0.9**
39	**M**	**43**	**Failed to reach the tip**	**2.2**
40	**F**	**18**	**reached the tip**	
41	**M**	**56**	**Failed to reach the tip**	**.0.5**
42	**F**	**17**	**reached the tip**	
43	**M**	**52**	**Failed to reach the tip**	**1.3**
44	**M**	**70**	**Failed to reach the tip**	**2.3**
45	**M**	**10**	**Failed to reach the tip**	**1.2**
46	**F**	**48**	**Reached the tip**	
47	**M**	**80**	**Failed to reach the tip**	**0.5**
48	**M**	**32**	**Failed to reach the tip**	**1.4**
49	**M**	**37**	**reached to reach the tip**	
50	**M**	**40**	**Failed to reach the tip**	**2.2**

TABLE VIII

ARTERIAL PATTERN OF THE APPENDIX

Sl. No.	Sex	Age in Yrs	No. of Appendicular Artery	Arterial Pattern
01.	F	25	2	Type 5
02.	F	70	1	Type 1
03	M	33	2	Type6
04	M	15	2	Type6
05	M	38	1	Type1
06	M	25	1	Type2
07	F	30	1	Type4
08	M	40	1	Type1
09	M	29	2	Type6
10	M	80	1	Type1
11	F	62	1	Type2
12	M	45	1	Type1
13	M	65	1	Type3
14	F	18	1	Type2
15	F	63	1	Type3
16	M	39	1	Type1
17	M	40	1	Type4
18	M	30	1	Type4
19	M	48	1	Type1
20	M	48	1	Type4
21	F	35	1	Type1
22	M	38	1	Type4
23	F	40	2	Type6
24	M	18	1	Type2
25	F	35	2	Type5
26	M	46	1	Type2
27	M	49	1	Type4

28	**F**	**45**	**2**	**Type5**
29	**M**	**35**	**2**	**Type5**
30	**M**	**50**	**1**	**Type1**
31	**M**	**42**	**2**	**Type6**
32	**F**	**19**	**2**	**Type6**
33	**M**	**48**	**2**	**Type7**
34	**F**	**52**	**2**	**Type5**
35	**M**	**48**	**1**	**Type1**
36	**M**	**38**	**2**	**Type5**
37	**M**	**58**	**1**	**Type2**
38	**M**	**59**	**1**	**Type2**
39	**M**	**43**	**2**	**Type5**
40	**F**	**18**	**1**	**Type1**
41	**M**	**56**	**1**	**Type1**
42	**F**	**17**	**2**	**Type5**
43	**M**	**52**	**2**	**Type6**
44	**M**	**70**	**2**	**Type5**
45	**M**	**10**	**1**	**Type4**
46	**F**	**48**	**1**	**Type4**
47	**M**	**80**	**1**	**Type1**
48	**M**	**32**	**1**	**Type4**
49	**M**	**37**	**1**	**Type2**
50	**M**	**40**	**1**	**Type 2**

TABLE IV

POSITION OF APPENDIX

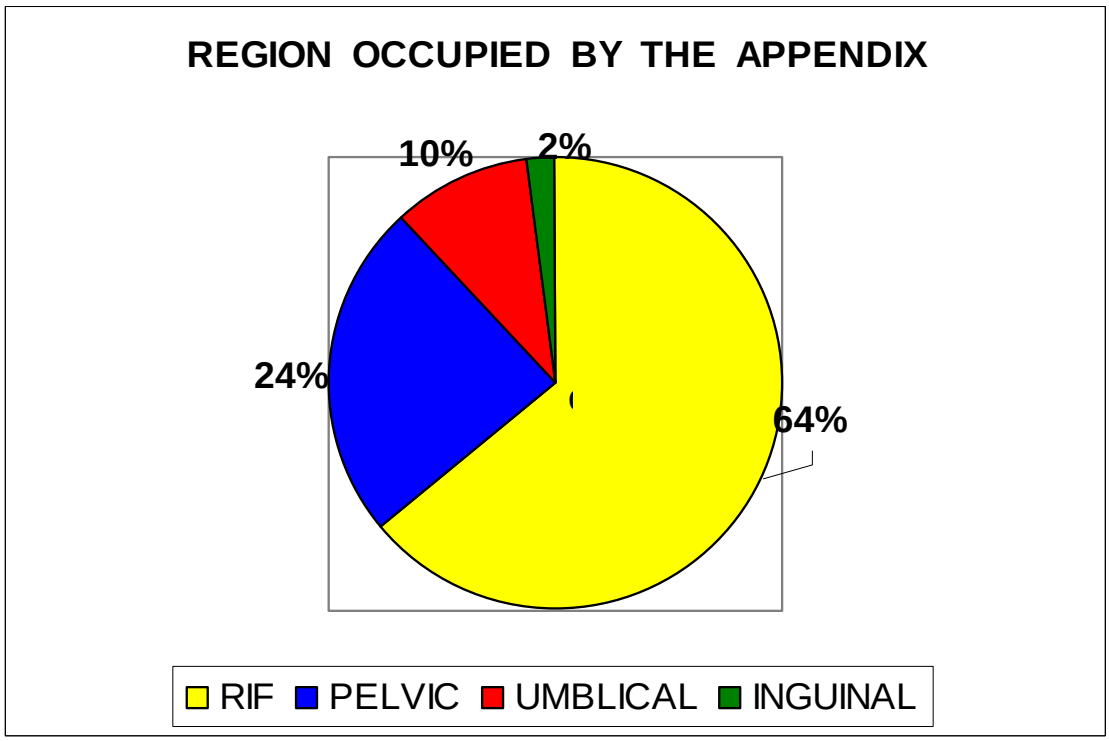
POSITION	NO.OF SPECIMENS	MALE	FEMALE	PERCENTAGE
RETROCAECAL	20	14	6	40.00
RETROCOLIC	12	9	3	24.00
PELVIC	12	7	5	24.00
PREILEAL	1	1	0	2.00
POSTILEAL	4	3	1	8.00
SUBCAECAL	1	1	0	2.00

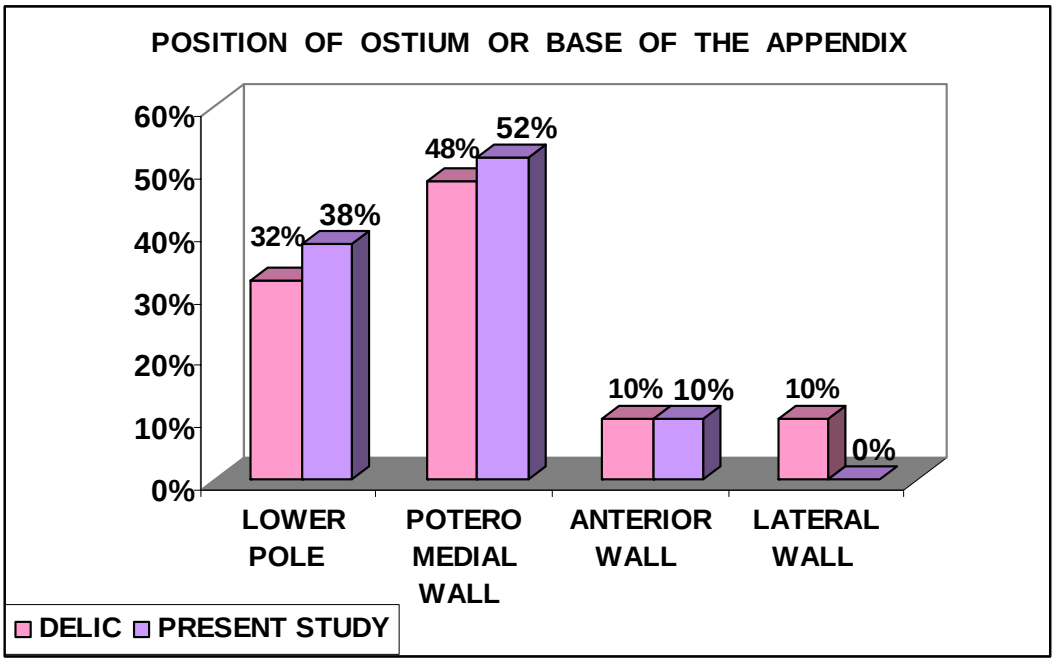
POSITION OF APPENDIX IN MALE

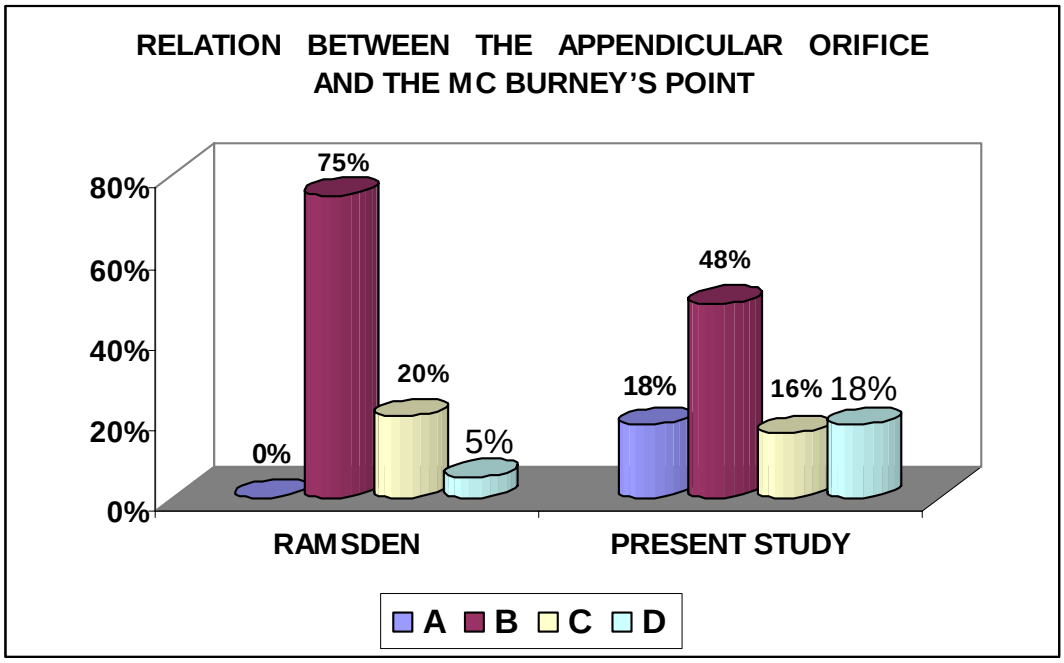
POSIT ION	FREQUENCY	PERCENTAGE
RETROCAECAL	14	28
RETROCOLIC	9	18
PELVIC	7	12
PREILEAL	1	2
POSTILEAL	3	6
SUBCAECAL	1	2

POSITION OF THE APPENDIX IN FEMALE

POSITION	FREQUENCY	PERCENTAGE
RETROCAECAL	6	12
RETROCOLIC	3	6
PELVIC	5	10
PREILEAL	0	0
POSTILEAL	1	2


REGION OCCUPIED BY THE APPENDIX
10%
2%
24%
64%
RIF
PELVIC
UMBLICAL
INGUINAL


POSITION OF OSTIUM OR BASE OF THE APPENDIX
60%
50%
40%
30%
20%
10%
0%
32%
38%
48%
52%
10%
10%
10%
0%
LOWER POLE
POTERO MEDIAL WALL
ANTERIOR WALL
LATERAL WALL
DELIC
PRESENT STUDY

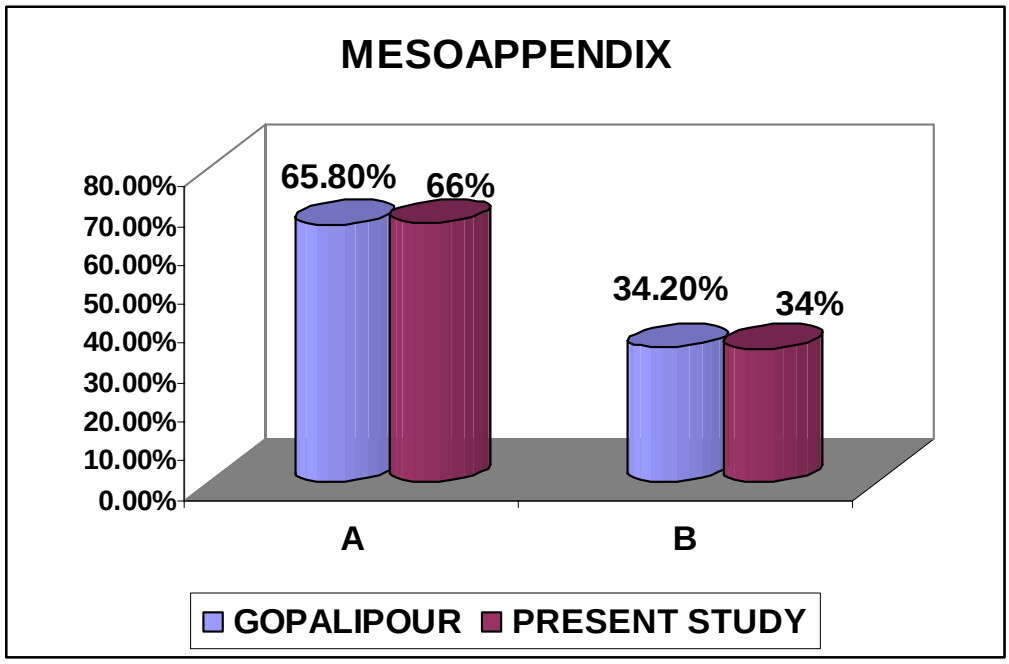


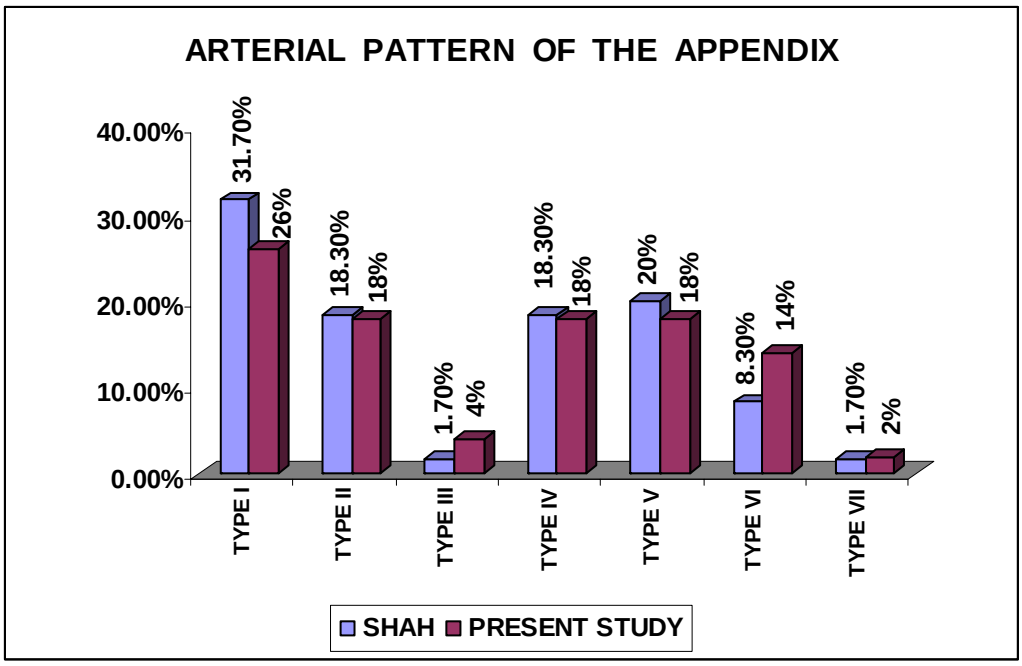
A: BASE SITUATED IN THE MC BURNEY'S POINT

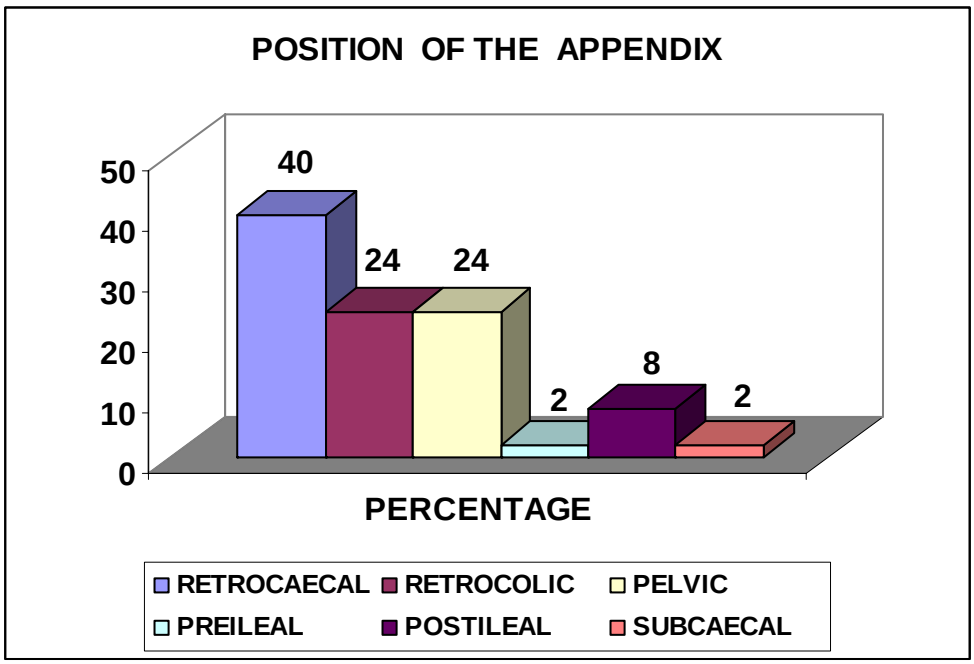
B: BASE SITUATED MEDIAL TO AND WITH IN 5CMS OF MC BURNEY'S POINT

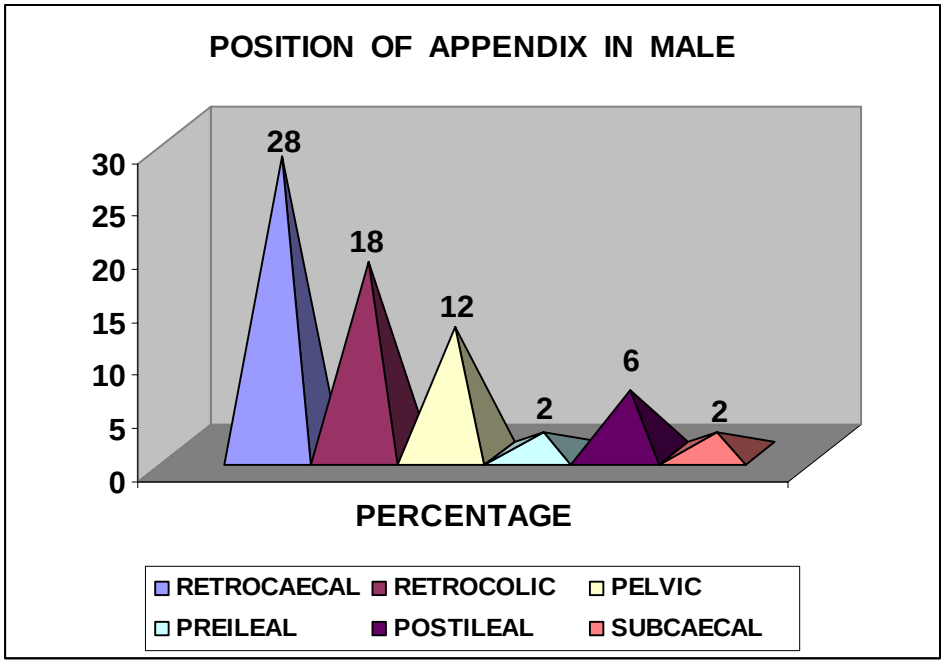
C: BASE SITUATED MEDIAL TO AND WITH IN 10CMS OF MC BURNEY'S POINT

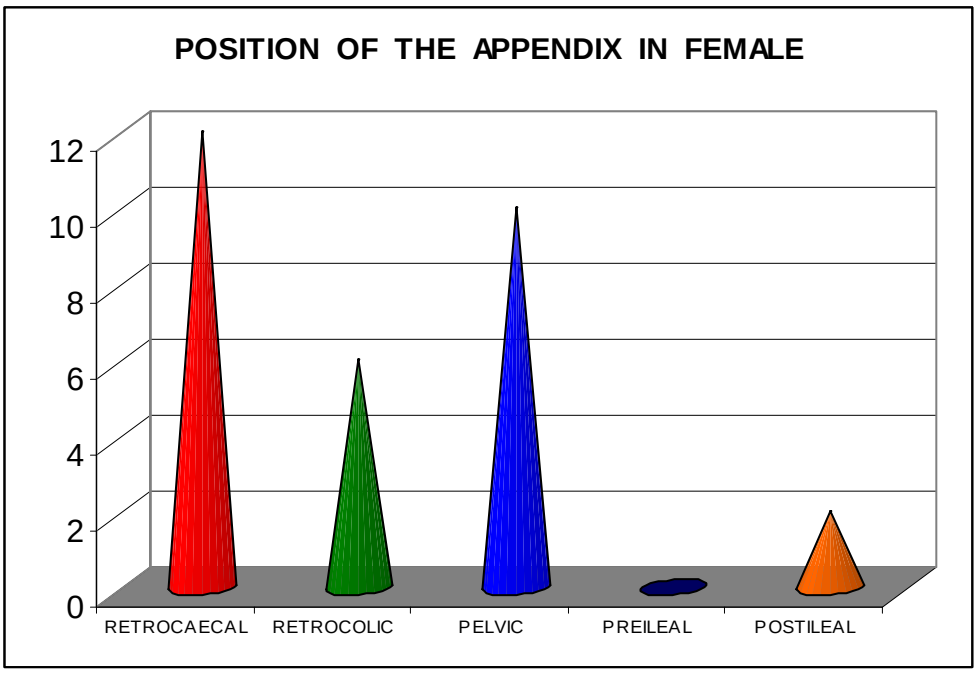
D: BASE SITUATED LATERAL TO MC BURNEY'S POINT

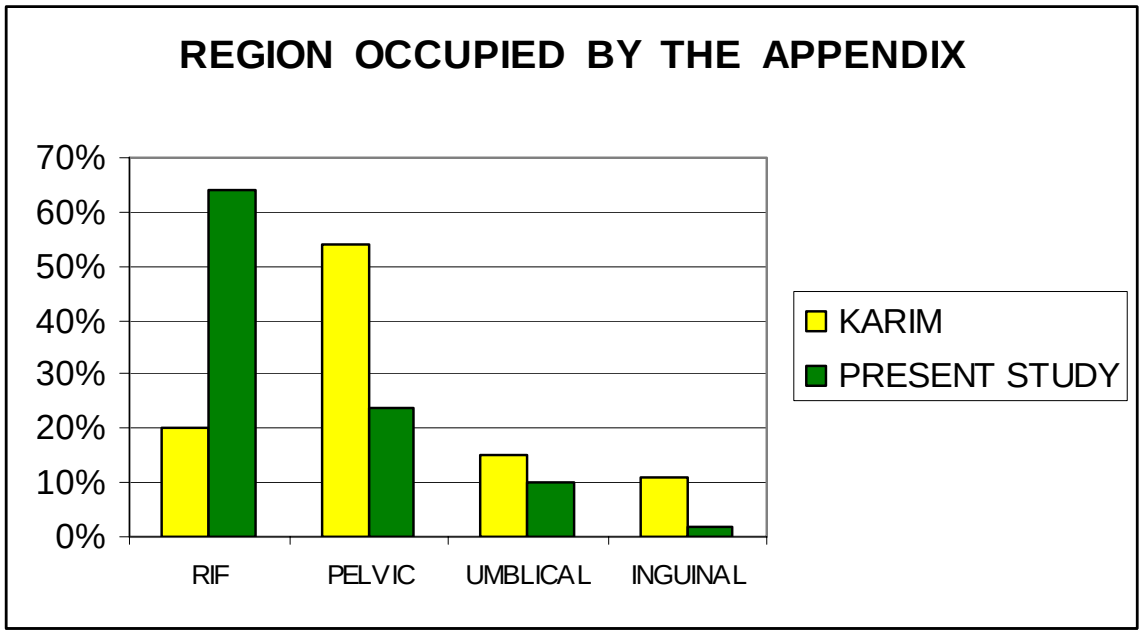

MESOAPPENDIX
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
65.80%
66%
34.20%
34%
A
B
GOPALIPOUR
PRESENT STUDY


ARTERIAL PATTERN OF THE APPENDIX
40.00%
30.00%
20.00%
10.00%
0.00%
31.70%
26%
18.30%
18%
1.70%
4%
18.30%
18%
20%
18%
8.30%
14%
1.70%
2%
TYPE I
TYPE II
TYPE III
TYPE IV
TYPE V
TYPE VI
TYPE VII
SHAH
PRESENT STUDY


POSITION OF THE APPENDIX
50
40
30
20
10
0
40
24
24
2
8
2
PERCENTAGE
RETROCAECAL
RETROCOLIC
PELVIC
PREILEAL
POSTILEAL
SUBCAECAL


POSITION OF APPENDIX IN MALE
30
25
20
15
10
5
0
28
18
12
2
6
2
PERCENTAGE
RETROCAECAL
RETROCOLIC
PELVIC
PREILEAL
POSTILEAL
SUBCAECAL


POSITION OF THE APPENDIX IN FEMALE
12
10
8
6
4
2
0
RETROCAECAL
RETROCOLIC
PELVIC
PREILEAL
POSTILEAL


REGION OCCUPIED BY THE APPENDIX
70%
60%
50%
40%
30%
20%
10%
0%
RIF
PELVIC
UMBLICAL
INGUINAL
KARIM
PRESENT STUDY